## ***ERRATA***

Please note the following corrections to the *Proposed Hydro-Québec Development Plan 1990-1992 – Horizon 1999*

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On page 5, left column, second to last paragraph, last line, replace "from 1998 to 2001" with:

"from 1998 to **2000**"

---

On page 5, right column, 9th line from the end, replace "whose earliest commissionings are planned for 2001," with:

"whose **first** commissionings are planned for 2001 **in the average scenario,**"

---

On page 9, right column, last line, replace "an increase of 37%" with:

"an increase of **39%**"

---

On page 36, right column, 4th line from top, replace "by the middle of 1990" with:

"by the middle of **the 1990s**"

---

On page 42, left column, 6th line, replace "5.2 terawatthours" with:

"**7.4** terawatthours"

---

On page 47, in the table, replace the note with:

**"The forecast in the 1989-1991 Development Plan was based on normal weather conditions. The variation of 2.2 terawatthours in relation to the actual 1989 situation is related to the colder weather in 1989. The variation in 1990 is due to the temporary buyback of commercial, institutional and industrial dual-energy contracts."**

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On page 69, in the table, on the line "Energy (in terawatthours)," replace the 10.0% in the column "% of total sales, 1991," with:

"**8.3%**"

Also in the table, on the line "Power (in megawatts)," under "Export sales, 1991, 1996, 2001," replace the figures 438, 948 and 2 550 with, respectively :

"**563**", "**1,487**" and "**3,050**"

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# PROPOSED HYDRO-QUÉBEC DEVELOPMENT PLAN 1990-1992 HORIZON 1999

*Montréal, March 1, 1990*

*Madame Lise Bacon*
*Deputy Prime Minister of Québec and*
*Minister of Energy and Resources,*
*Responsible for Regional Development*
*Québec City*

*Dear Madam,*

*Hydro-Québec hereby presents to you its strategies for future development, with special regard to the years 1990, 1991 and 1992.*

*To fulfill the mandate set out in the Hydro-Québec Act, Hydro-Québec must forecast the province's energy needs and determine ways of meeting these needs in accordance with the energy policies of the Québec government.*

*In this proposed Development Plan we first review the present energy situation. Then, using various assumptions of demographic, economic and energy development, we establish forecast scenarios for high, average and low growth in the demand for electricity. We propose ways of meeting that demand, while applying the principle of sustainable development that respects the environment. Options include the construction of new generating and transmission facilities and the rehabilitation of existing facilities for increased productivity. We also pay special attention to means of improving electrical efficiency, because we believe that these can help moderate the increase in the demand for electricity.*

*In addition, we present our objectives and strategies with regard to quality of service and the utility's internal operations. Our financial forecasts have been revised to take into account the forecast changes in cost and revenue factors, and Hydro-Québec's self-financing requirements.*

*The Québec government has decided to seek general consultation and hold public hearings on the present energy situation and the role of electricity in meeting Québec's future energy needs. We will participate actively and openly in this debate and are prepared to reevaluate our orientations accordingly.*

*Yours respectfully,*

*Richard Drouin*

*Chairman of the Board and Chief Executive Officer*

*Claude Boivin*

*President and Chief Operating Officer*

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*Note to Readers*

Unless otherwise indicated, the data in this document are those of Hydro-Québec.

All dollar amounts are Canadian dollars unless otherwise indicated.

**Symbol for Units of Measurement**

J – joule (unit of energy)

kV – kilovolt (unit of voltage)

kWh – kilowatthour (unit of energy)

GWh – gigawatthour, or 1 million kilowatthours

TWh – terawatthour, or 1 billion kilowatthours

MW – megawatt (unit of power)

# 1

# A COMMITMENT TO THE FUTURE

Hydro-Québec's mandate is to supply electricity to Québec at the best possible terms and to make the most of the comparative advantage that hydroelectricity offers. In fulfilling its mandate, the utility has five major concerns:

- to have a level of quality of service that meets customer expectations;
- to promote the efficient use of electricity and ensure optimal and flexible development of the hydroelectric resource that is compatible with sustainable development, i.e. in harmony with the environment;
- to mobilize human resources;
- to remain financially sound; and
- to demonstrate economic and technological leadership that reflects the needs of the utility and its partners.

With the cooperation of its personnel, suppliers and contractors and together with land-use planners and developers, Hydro-Québec will meet the expectations of the people of Québec and the utility's three principal partners: its customers, who are its raison d'être; its shareholder, the Québec government, which determines energy policy and defines the utility's mandate; and its lenders, who supply three-quarters of the capital needed.

Much of 1989 was devoted to the preparation and introduction of a number of major service-quality enhancement programs, as mentioned in last year's Development Plan. These programs are now under way, in spite of work slowdowns related to contract renegotiation. In addition, the utility began rescheduling its ongoing activities, focusing on sectors with the poorest performance and on activities that have an immediate impact on continuity of service, such as tree-trimming. These activities involving the distribution system, combined with more favorable climatic conditions, resulted in a reduction in average service-interruption time, meeting the utility's short-term goals in this area.

Meanwhile, a number of events combined to alter the balance between supply and demand. On the one hand, consumption of electricity in Québec continued to increase rapidly, and demand forecasts for 1992 and beyond, taking into account the new aluminum smelters and a higher household-formation estimate, have been revised upward. On the other hand, another year of runoff well below average levels intensified the decline in energy reserves. To maintain the balance between supply and demand, Hydro-Québec had a number of options. First, the utility decided to move up, to the extent possible, the commissioning of three generating stations under construction at La Grande complex. Then, to reconstitute short-term energy reserves, it temporarily reassigned Tracy thermal generating station to base-load production, bought back dual-energy boiler supply contracts in Québec for a one-year period, and purchased electricity from neighboring systems. Whether to continue, expand or reduce the application of these types of measures will be decided in the fall of 1990, once the year's runoff levels are known. The substantial increase in overall power requirements has put some pressure on short-term reserves, in spite of the projected commissioning of gas turbines in 1992 and 1993.

In the area of labor relations, four agreements were signed, including one with SPIHQ, the engineers' union. However, the goal of renewing collective agreements with some 16,000 permanent and temporary employees affiliated with the Canadian Union of Public Employees (CUPE) was not achieved in 1989.

In spite of the strength of the Québec economy, the utility's net income for 1989 was down by $54 million compared with 1988 because of higher expenditures and revenue losses due to low runoff. This meant that return on equity in 1989 declined to 7%, continuing to fall short of the medium-term objective of meeting the cost of the debt.

## *1.1 Enhancing Quality of Service*

Improving quality of service is of paramount concern for Hydro-Québec, which is responsible for doing its best to serve Québecers' needs. Concern for service quality also applies to deliveries to neighboring systems in Canada and the United States.

Customers vary by category (residential, general or industrial), the amount of their consumption and range of services required. Customers expect, first and foremost, a reliable supply of electricity. They also want rapid connection, an accurate and simple bill, and a choice of payment methods. They appreciate advice on safety and energy conservation. Moreover, they want easy access to business offices, satisfactory settlement in case of error, and service which is courteous, personalized, understanding and flexible. Finally, they want to be warned of any temporary service interruptions planned by the utility in their sector.

All customers deserve continuous, high-quality service. This was reaffirmed by Hydro-Québec in last year's Development Plan in which it placed a new emphasis on its primary mandate: quality of service. This led to three major programs in 1989, for improvement of:

- quality of service of the distribution system (known by its French acronym, PAQS 2);
- maintenance of generating, transmission, sub-transmission and telecommunications facilities (known by its French acronym, PAM);
- quality of customer services (known by its French acronym, PAQS – Clientèle).

Quality of service was also pursued through the redeployment of ongoing operations and maintenance activities, and through enhanced service-quality support activities, including new emphasis on quality assurance in procurement, on R & D and on employee training. Furthermore, the utility has for several years now been revising its practices in various areas. It will therefore be implementing new, more stringent design criteria for the transmission and underground distribution systems, and a new preventive maintenance policy based on monitoring.

Directly or indirectly, quality control is the responsibility of all personnel. Moreover, each employee must be properly trained, the working climate favorable, objectives clear and consistent, results monitored and acknowledged, the organization of work appropriate and conducive to initiative, and human, material and financial resources must be sufficient.

This Development Plan aims to ensure that these requirements are met in order to guarantee the success of programs dedicated to product quality and customer-service quality. The ultimate goal of these programs is to see that Hydro-Québec equals the quality performance of the best Canadian electrical utilities by the mid-1990s. The utility will devote some $4 billion to achieving this goal. While this expenditure will mean higher supply costs and rates, Hydro-Québec's customers will benefit from:

- a transmission system designed according to the most stringent criteria in North America, with minimal probability of a general power failure;
- a distribution system as reliable as other Canadian systems that experience similar climatic conditions, which means a 50% reduction in service interruptions;
- improved customer services, with present causes of dissatisfaction reduced to the extent possible.

Quality of service also depends on how the utility meets its environmental obligations while operating its existing facilities. The orientations adopted by Hydro-Québec are an extension of its activities in this area for a number of years now, exemplified through its management programs for contaminants and hazardous wastes, reservoirs, and noise control, and through actions to better integrate the distribution system into its surroundings.

## *1.2 Balance between Supply and Demand and Sustainable Development*

A sufficient supply of electricity obtained under conditions that respect the environment is Hydro-Québec's constant goal. Since 1982, the utility has successfully met a 52.7% rise in Québec firm-electricity sales. Future electricity needs are determined according to various economic and demographic growth scenarios for Québec, and these forecasts are re-evaluated each year. Hydro-Québec's mandate is to satisfy this demand for electricity. To do so, it must have the necessary flexibility to optimize hyroelectricity's comparative advantage for Québec, in accordance with the principle of sustainable development.

This principle, proposed by the World Commission on Environment and Development, was adopted by the utility in 1988. It suggests that development be optimized in a manner which, while respecting the planet's ecological limits, does not compromise the ability of future generations to meet their needs.

The first part of Hydro-Québec's contribution towards achieving sustainable development is to promote energy conservation, regardless of the demand scenario. Conservation is cost-effective for customers and, when integrated into the utility's strategic planning, it allows the installations plan to be modified to be more in tune with Québec's real future needs. Energy conservation programs must, however, be accompanied by an adequate rates structure, i.e. one based on the costs of supply.

The second part of Hydro-Québec's contribution consists of developing Québec's hydroelectric resources in harmony with the environment and in consultation with all interested parties. This is why Hydro-Québec conducts its study of cumulative environmental effects, and impact-assessment studies for each project.

**Electrical Efficiency**

The promotion of the efficient use of electricity is essential to carrying out the utility's mandate. This is not a new concern for Hydro-Québec. In the past, the utility has been very active in establishing standards for appliances and home insulation. During the period of major energy surpluses which followed the 1981-1982 recession, it concentrated on peak-load management through dual-energy and interruptible power programs. Now that supply and demand are back in balance, Hydro-Québec is placing a new emphasis on all its activities that affect demand, and at the beginning of the 1990s it is instituting a major permanent program to promote energy conservation.

Programs to promote efficient use of electricity are also a part of customer service. These programs will offer customers additional means to reduce their consumption and lower their electricity bills. This not only makes good business sense by increasing customer satisfaction, but also makes good economic sense compatible with sustainable development; everyone comes out ahead when waste is eliminated through energy conservation methods that cost less than would the generation of additional electricity. Québec's long-term economic development also benefits from the increased margin of manoeuvre resulting from hydroelectric resources made available through conservation.

Energy conservation programs have already made a major contribution to the insulation of buildings and water heaters in Québec. However, a significant potential for energy conservation remains. Of this potential, Hydro-Québec is backing those measures that are cost-effective for customers and the utility; neither customers' quality of life nor long-term rates will be adversely affected. The utility will devote about $1.8 billion by the end of the 1990s to programs involving specific energy-conservation measures.

Hydro-Québec's activities promoting electrical efficiency also affect peak-load management by shaving the demand through dual-energy systems and through interruptible power adopted by large industries. Combined with the impact of energy conservation programs, these measures will reduce growth in priority needs for power by some 5,600 megawatts by 2001, equivalent to the power now required on the Island of Montréal.

**Hydroelectric Projects**

Energy conservation and peak-load management will, however, meet only part of the growth in demand in Québec.

Based on reasonable assumptions concerning demographic, economic and energy growth, and taking into account measures aimed at electrical efficiency, Hydro-Québec anticipates it will have to meet a 40% rise in electricity demand between now and 2006, in the average scenario.

The utility has an available capacity of 30,000 megawatts. The undeveloped potential of the province's large and small rivers is 50,000 megawatts. Studies conducted to date have determined that approximately 18,800 megawatts of this total is economically viable compared with base-load generating options such as coal-fired or nuclear plants.

Were all projects developed in this economically viable potential, the utility's installations would occupy 2% of the province in the next century, compared to 1% today. Initial results of the study of cumulative environmental effects show that these developments will not have major effects on the climate, underground water tables, wildlife habitat and resources, and estuarine environments. This first conclusion takes into account the fact that each project will receive a rigorous impact-assessment study and appropriate mitigative measures. Nevertheless, interactions between resources and their users mean that these projects are liable to have significant cumulative effects in three areas of the human environment: organization and structure of the area, regional economies, and lifestyles of the Native Peoples. Mitigating and managing these effects are possible through an enlarged implementation strategy, focusing on increased collaboration with communities affected, with other land users and with land-use and resource planners and developers.

Sufficient time must therefore be set aside to involve the interested parties in the process of developing this economically viable hydroelectric potential. Accordingly, the utility has revised last year's forecast of the earliest commissioning of the first generating units of the Nottaway-Broadback-Rupert (NBR) complex from 1998 to 2001.

Without Hydro-Québec's intervention, growth in Québec demand could impose an unrealistic schedule on the commissioning of hydroelectric facilities in the 1990s. Promoting energy conservation is therefore another way of achieving sustainable development, by allowing more flexibility for resource-development decisions.

**Flexibility in Adaptation**

The long lead times required to build major electricity generating and transmission facilities mean that Hydro-Québec must forecast the evolution of demand, and ways of meeting that demand, over a minimum 10-year period. Many unpredictable events can alter this pattern; thus the use of a range of scenarios for long-term demand and runoff cycles.

The utility bases the construction of its new installations on the average-demand scenario. However, given the time required for studies, consultation and construction, it is easier to adjust the construction program downward rather than upward, so the utility plans its studies and applications for government authorization using the strong-demand scenario. Any decision to begin construction is only made after authorizations have been obtained, based on the most recent demand forecasts.

To cover risks associated with cyclical phenomena such as low runoff or strong economic recovery, Hydro-Québec must also have reserves of energy and power. Thus, in addition to efforts to improve quality of service, it has increased its reserve requirement in order to ensure the long-term reliability of electrical supply. To cope with factors like high runoff and economic slowdowns, Hydro-Québec maintains such flexible markets as exports of surplus electricity and industrial boilers.

Despite energy conservation, the ability to adapt to strong demand will be reduced in the 1990s. Over this period, long construction times limit the quantity of energy that can be obtained from the stock of economically viable and environmentally acceptable hydroelectric projects. The process of environmental studies, consultation with the Native communities and other groups, preparation of appropriate mitigative measures and the obtaining of government authorizations prevents the execution of large projects before 1998-1999, except those already under way at the La Grande complex. Authorization for Grande Baleine (3,060 megawatts at the peak) is the keystone in the balance between supply and demand in the medium term. The first commissionings of this complex are planned for 1998 at the earliest. The Nottaway-Broadback-Rupert complex (8,400 megawatts at the peak), whose earliest commissionings are planned for 2001, and which can be executed in several phases depending on demand, will give the utility all the required long-term flexibility. This project represents nearly 45% of the economically viable hydroelectric potential.

**Choice of Markets**

For many years now, Québecers have opted in large numbers for electric heating. Some 71% of Québec residences, and more than 90% of new homes, are heated by electricity. For all consumption sectors, electric heating represented about 23% of Québec sales in 1989; when water heating is included, this figure rises to 31%.

Electricity's strong saturation of the heating market has greatly contributed to boosting Québec's energy self-sufficiency. In fact, electricity's share among the province's conventional energy sources rose from 19.5% in 1971 to 39.3% in 1989. Substituting electricity for oil has led to major improvements in terms of energy productivity, given the greater efficiency of electric heating systems.

However, current rates do not adequately reflect the cost of supply in the case of the residential all-electric heating market. This is because of the particular nature of the load or demand on the electricity grid, which requires additional generating and other facilities in winter. Consequently, the utility promotes energy conservation options such as dual-energy systems and the implementation of a rates policy which better reflects costs. Customers will then be more sensitized to the importance of using energy wisely.

Beyond meeting Québecers' basic needs, what guides Hydro-Québec's choice of markets is the desire to optimize a collective resource. Hydroelectricity represents one of Québec's major economic assets in the North American context. Accordingly, the use of this comparative advantage to bring industries consuming large amounts of energy to Québec is an important facet of the Québec government's industrial policy. And Hydro-Québec incorporates in its forecast of demand the margins of manoeuvre necessary for Québec to be able to seize interesting opportunities for industrial development. Its risk-and profit-sharing program and incentives to introduce promising electrical processes into industry have proven to be effective levers for development.

Exports constitute another market choice for Québecers. Development of exports to neighboring systems has already brought major benefits to Québec. In the 1980s, more than $5 billion in revenue was reinvested in the utility's activities, thus avoiding major rate shocks in Québec and leading to better utilization of facilities after the 1981-1982 recession. The development of interconnections also enabled Québec to become better integrated with northeast US and Canadian power systems and strengthened its capacity to face variations in supply and demand by temporarily importing power and energy.

There is a significant long-term potential on export markets which allows the utility to select the most profitable markets for thermal-generation replacement from among neighboring systems. Exports are therefore one of the uses of hydroelectricity with the highest economic value for Québec. From a more general environmental point of view, exporting hydroelectricity to neighboring systems contributes in the long term to reducing acid rain and the greenhouse effect, for which their thermal generating stations are partially responsible.

Starting in the year 2000, Québec has the option of moving up for export purposes those hydroelectric projects included in the potential of 18,800 megawatts and not required for internal demand for electricity until much later. This is compatible with realistic commissioning dates that allow a harmonious integration of the economic, social and environmental aspects of these projects. Additional exports of electricity over and above the agreements already signed can then be made for 15 to 20 years without harming Hydro-Québec's ability to achieve its primary goal of satisfying demand in Québec. These contracts are very advantageous for all parties, and at their expiry the utility recovers the electricity generated at these installations for Québec's needs. Furthermore, since these installations will be built earlier than planned, they will cost less than under the original construction schedule.

Accordingly, Hydro-Québec reaffirms its objective of exporting at least 3,500 megawatts of firm power and energy after the year 2000, when these exports will represent some 10% of total sales.

**Other Development Choices**

There may be other approaches to development that differ from those proposed by Hydro-Québec. However, in the short and medium term the realistic options are limited.

One is to use energy conservation as the primary means to satisfy growing needs. This approach would, however, constitute just as extreme a position as counting solely on new generating facilities.

Given the present state of knowledge, it would be imprudent to depend on much greater energy conservation than that already incorporated in demand forecasts, and which is compatible with incentive measures while being cost-effective and fair. Too great a reliance on energy conservation in the medium term would instead mean dependence on thermal generation and the restriction of certain markets. For example, it would be necessary to limit the quantities of electricity available for the development of large-power industries, or halt the penetration of electric heating, mainly by raising rates – possibly applying a rates policy based on the average cost of new installations, rather than the cost of all generating facilities.

In the longer term, Québec could decide not to sign new export agreements, but this solution would not obviate the need to commission major projects, even if their construction is delayed. In the meantime, Québecers would be collectively poorer, and there would be increasing atmospheric pollution in the northeastern part of the continent.

Another approach Québec could take is to maximize the economic value of hydroelectricity to an even greater degree than is proposed in the present Development Plan. As hydroelectricity is at its most valuable as an export, it could be more profitable to promote a broader range of energy sources for heating in Québec, so as to free up a proportion of electrical output for additional exports abroad.

**Hydro-Québec's Proposal**

Hydro-Québec believes that the development orientations it proposes are reasonable and that they offer the flexibility to meet the real needs of Québec, respect the environment and optimize the value of the resource by selective market choices.

The approach to development proposed by Hydro-Québec consists of the following choices:

- meet Québec's energy needs, including heating, while actively encouraging electrical efficiency and ensuring that rates reflect the average cost of supply;

- maintain electricity's present role as an important tool for economic development. To this end, stimulate industrial development and promote the use of highly energy-efficient electrotechnologies;

- promote profitable electricity exports by moving up hydroelectric projects that will be required for Québec only when related export contracts expire;

- develop economically viable hydroelectric resources in cooperation with major interested parties. At the same time, ensure that the environment is respected, mainly by carrying out studies necessary to optimize appropriate mitigative measures.

The utility is convinced that Québec would lose a major advantage if it did not seek to reconcile these diverse objectives. Accordingly, it is very receptive to the consultation that will take place with interested parties during hearings of the *Commission parlementaire sur la situation et les perspectives de l'énergie électrique au Québec*. This dialogue will make it possible to determine the social acceptability of developing the 18,800 megawatts of economically viable potential that are judged to be environmentally acceptable.

Hydro-Québec does not seek development at any price. However, delays in the authorization process could compromise the development scenario the utility believes to be most positive, and limit the choices available to Québec society, especially as regards hydroelectricity.

## *1.3 Mobilization of Human Resources*

To meet the challenges of the 1990s, Hydro-Québec needs the full participation of all employees. So it must determine with staff, managers and unions the conditions that facilitate the achievement of the utility's major objectives. There can be no doubt that the difficulties and disputes at Hydro-Québec in recent years have had an impact on the working climate and employee loyalty. Now the utility must rally and mobilize the men and women that are its vital strength.

Three approaches are required at this time. The first is to continue the mobilization activities begun last year with managers and specialists, by means of a strategic development plan that is more comprehensive and longer term, covering all employees. The second is to negotiate in the short term collective agreements that foster a new consensus, based on

quality of service, productivity and employee aspirations. Lastly, with moderate growth in staffing levels and the need for succession planning, the utility must, at the beginning of this new decade, improve the quality of its recruiting, both external and internal, and keep the technical, commercial and management skills of all its staff in the forefront of knowledge.

## *1.4 Maintenance of Financial Health*

Another essential condition for achieving the objectives of the Development Plan is the maintenance of a sound financial position.

Hydro-Québec's financial soundness, which has always been recognized, has given it ease of access to the capital markets for financing the investments required to satisfy the growth of Québec's needs. In just two decades, assets have risen from $4 to $34 billion, making Hydro-Québec one of the two largest non-financial corporations in Canada.

The utility's financial policy is clear: generate sufficient net income to cover the principal risks to which revenue and costs are exposed, ensure adequate self-financing of investments, maintain advantageous borrowing conditions and, at the same time, give an accurate price signal to customers.

In previous Development Plans, Hydro-Québec stated that by early in the 1990s it would have reconstituted a minimum financial margin as defined by the four following objectives:

- interest coverage of at least 1.0;
- capitalization of at least 25%;
- return on equity equal to or greater than the average cost of the debt;
- self-financing of at least 30%.

To achieve these interrelated objectives, the utility was counting on three principal strategies:

- productivity gains;
- the application of a rates policy reflecting costs of supply which includes an acceptable return on equity;
- developing profitable export markets.

In recent years, overall productivity has been increased through rationalization and the development of markets. Growth in operating expenditure, adjusted for inflation, was kept to an average of 1.9% per year from 1982 to 1988, as compared to about 10% per year between 1976 and 1982. Hydro-Québec will pursue its efforts by stressing individual productivity. Discussions to this effect are part of current negotiations with the unions. Rate increases have on average been below the rate of inflation for the last five years. The real price of electricity in 1989 was thus slightly less than it was in 1963. Finally, with regard to exports, over the past five years the utility has achieved sales in excess of $2.8 billion.

Thanks to these three strategies, there has been a gradual improvement in the financial health of the utility. Thus, return on equity rose from 4.7% in 1984 to 8.0% in 1988 and 7% in 1989 but this is still below the cost of the debt, which stood at 11.2% last year.

Two factors now slow down the desired improvement in financial health and widen the gap between rates and costs of supply. First, the need to reconstitute water reserves will mean major increases in expenditure, and revenue losses in the short term: $267 million in 1989 and $314 million in 1990, assuming that runoff returns to average in 1990. Second, in the medium term costs are being forced upwards by stronger growth in demand, the downward revision of average output of generating stations, new service-quality enhancement programs and the launching of energy conservation programs whose full benefits will only be felt later. The postponement of certain firm power and energy exports will also have an adverse effect on the improvement of Hydro-Québec's overall financial health.

The problems with runoff illustrate how crucial it is to have sufficient financial margin of manoeuvre to absorb the major variations in supply and demand. Had Hydro-Québec been able to reconstitute the desired margin, it could now consider absorbing a large portion of the negative shocks it is currently experiencing. Unfortunately, this option is not available. Moreover, after the slowdown in investment that followed the 1981-82 recession, Hydro-Québec is now facing renewed spending on large-scale construction and intensive service-quality enhancement programs.

Investment for the average-demand scenario will now be more than $8 billion higher for the 1990-1998 period than was forecast in last year's Development Plan. Some $62 billion is currently projected for the 1990-1999 period, $13 billion of which will be for the next three years. In this context, it is more essential than ever to achieve financial policy objectives.

Steps must be taken to stop the gap between rates and costs of supply from becoming wider. But to avoid excessively large rate increases, Hydro-Québec proposes to spread the rates recovery over two years, with two general rate increases of 7.5% per year. This is a minimum rate of recovery, in 1990 generating only the income required, before interest and exchange loss, to cover gross interest charges. Only in 1992 will the utility begin to approach all of the minimum objectives of its financial policy.

A more accurate reflection of real costs will promote the efficient utilization of electricity and contribute to sustainable development. Electricity will nonetheless remain competitive with other energy sources in Québec, and Québec's electricity prices will remain attractive compared to those in North America as a whole.

## *1.5 Economic Spinoffs and Technology*

Acting as a catalyst for the Québec economy in its activities as employer, purchaser, vendor and researcher, is a fundamental role for Hydro-Québec as a Crown corporation. In 1989, the utility supported jobs evaluated at 62,500 person-years in Québec, and this number will grow substantially by 1992, reaching more than 87,000, an increase of 37%.

For the work force, suppliers and subcontractors, hydroelectricity is undoubtedly the source of energy with the highest Québec content — 76% in 1989 — and the greatest spinoffs. It generates a large volume of economic activity through construction and operation of electrical facilities, which currently represents about 5% of Québec's Gross Domestic Product.

Moreover, Hydro-Québec's procurement policy seeks not only to increase the Québec content of its purchases but also stresses quality assurance and local R & D. This can give suppliers a marked competitive edge in world markets.

The utility also stimulates the inflow of major investment to Québec. For industrial customers, Québec's hydroelectricity is a high-performance energy with many uses: manufacturing, processing, heating, handling and high technology. And customers are offered technical and financial support in introducing energy-efficient electrotechnologies into their industrial processes.

Technology plays a key role at Hydro-Québec: not only was it at the core of the utility's achievements in expanding and operating its huge power system over recent decades, but it will also play a vital part in the future in solving the problems associated with quality of service, the environment, employee health and safety, and cost-effective investments.

With forecast spending on research and development of nearly half a billion dollars over the next three years, putting it among Canadian leaders in this regard, Hydro-Québec remains a driving force of technological development in Québec. And it will continue to broaden its technological activities by forging closer links with industry, government and non-governmental research centres, and universities.

It is currently deploying efforts in four long-term avenues related to the generation, transmission and utilization of electricity: nuclear fusion, superconductivity, hydrogen and polymer-electrolyte (ACEP) batteries. Here, as in all else, the utility reaffirms its commitment to the future.

# 2

# IMPROVING QUALITY OF SERVICE

Quality of service has always been one of Hydro-Québec's paramount concerns. While the utility's efforts brought about an improvement in service continuity between 1982 and 1986, a series of factors resulted in deterioration in this area in recent years. Consequently, the utility placed new emphasis on activities affecting all aspects of quality of service.

Hydro-Québec will raise its performance to a level comparable to that of the best electrical utilities. To achieve this, it has set specific goals for progressive improvements over the coming years both in the quality of product supplied and in the quality of customer relations.

## *2.1 Product Quality*

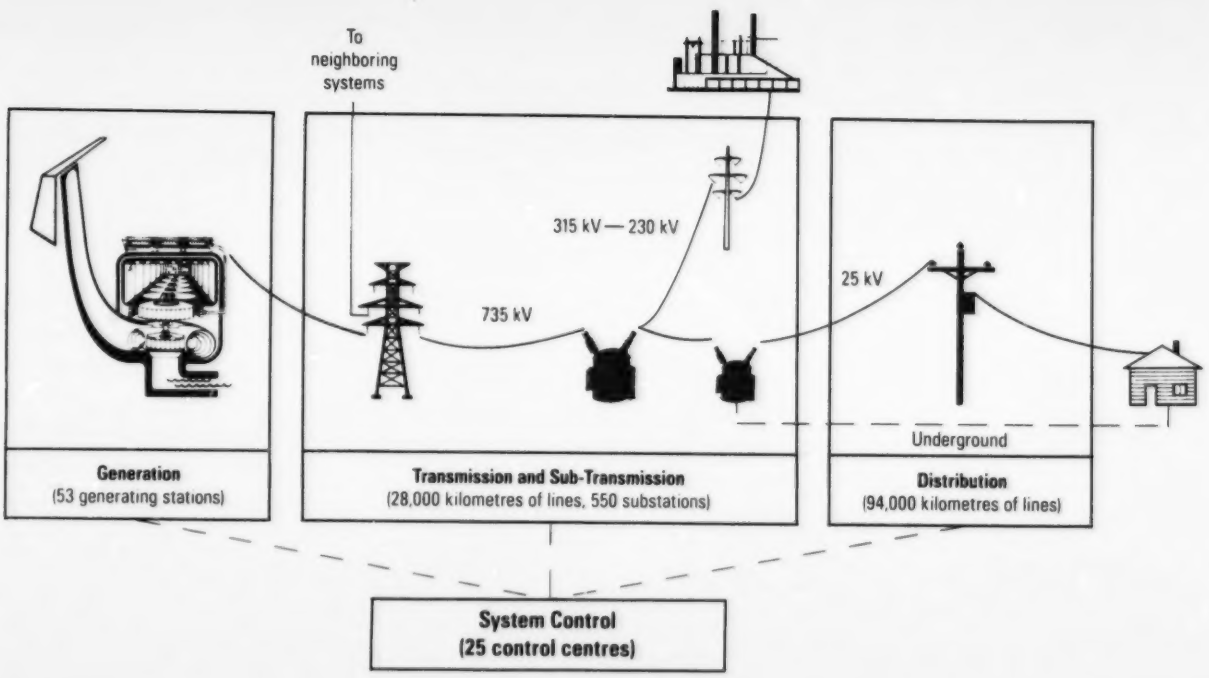
Continuity of service is a major concern for the utility. The Hydro-Québec system contains a large amount of equipment whose behavior affects service continuity.

Energy is generated primarily by 53 hydroelectric generating stations, scattered across the province of Québec. Their output is carried to the distribution system, to the province's major industrial firms and to neighboring systems by the transmission and sub-transmission systems, containing some 550 transformer substations and more than 28,000 kilometres of lines.

The distribution system supplies residential, commercial and institutional customers and small- and medium-sized industrial firms in Québec with medium and low voltage. It delivers electricity to nearly three million customers through 94,000 kilometres of medium voltage lines, 5,800 of which are underground.

Completing this system are the telecommunications facilities, automatic-control devices and operations centres essential to proper operation and vital to its performance.

**Diagram 2.1**
Principal Installations Supplying Customers




Customer-service interruptions have a number of causes, usually divided into two different categories:

- power failures due to equipment breakdown or due to random events caused by factors external to the system, principally trees and branches, wind and lightning;
- scheduled service interruptions, allowing the utility to perform maintenance and system modification work.

While quality of service can be evaluated on the basis of the total number of service interruptions during the year, this number only partially reflects the impact of interruptions on customers. Each service interruption affects a highly variable number of customers and varies in length. For example, distribution-system failures are more frequent but affect fewer customers, while transmission system breakdowns are much less frequent but affect a much larger number of customers.

These variables have been taken into account in a more general indicator: the average annual service-interruption time per customer.

To analyse the evolution of this indicator, both provincially and regionally, it is useful for the utility to combine interruptions by the system on which they originate. This allows better definition of the measures to take and better follow-up of the results of these programs.

**Table 2.1**
Breakdown of Average Annual Service-Interruption Time per Customer by System of Origin
(in hours)

| | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|---|---|
| **Distribution** | 5.4 | 7.3 | 5.3 | 5.6 | 5.2 | 7.6 | 8.2 | 5.2 |
| **Transmission and sub-transmission** | | | | | | | | |
| • excluding general power failures* | 5.9 | 2.8 | 3.5 | 3.4 | 2.8 | 1.1 | 1.8 | 1.3 |
| • general power failures | | – | – | – | – | – | 5.3** | 8.1*** |
| **Generation** | – | – | – | – | – | – | – | – |
| **TOTAL** | 11.3 | 10.1 | 8.8 | 9.0 | 8.0 | 8.7 | 15.3 | 14.6 |

* A general power failure corresponds to total loss of power, and is caused by a problem on the transmission system.

** General power failure of April 18, 1988: ice caused a series of short circuits on the three phases of Arnaud substation which caused the loss of Churchill Falls generating station.

*** General power failure of March 13, 1989 caused by a high-intensity magnetic storm.

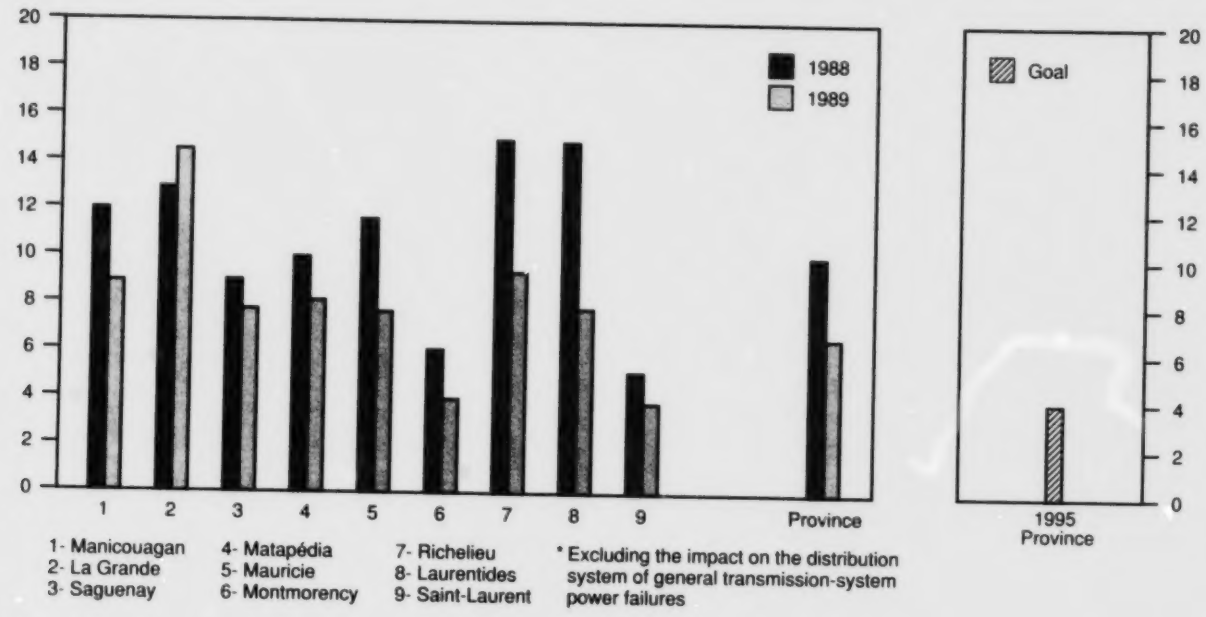
In 1988 and 1989 there was an improvement in average annual service-interruption time per customer on the distribution system, with interruptions dropping from 8.2 to 5.2 hours, exceeding the utility's goal for March 1990 of 6.1 hours. Transmission and sub-transmission system interruptions excluding general power failures dropped from 1.8 to 1.3 hours. However, the general power failure of March 13, 1989 adds 8.1 hours to the figure for each customer.

Changes in annual average service interruption time per customer observed between 1988 and 1989 will be discussed later in this chapter. Hydro-Québec's generating facilities have not been the cause of power failures or scheduled service interruptions that affect service continuity.

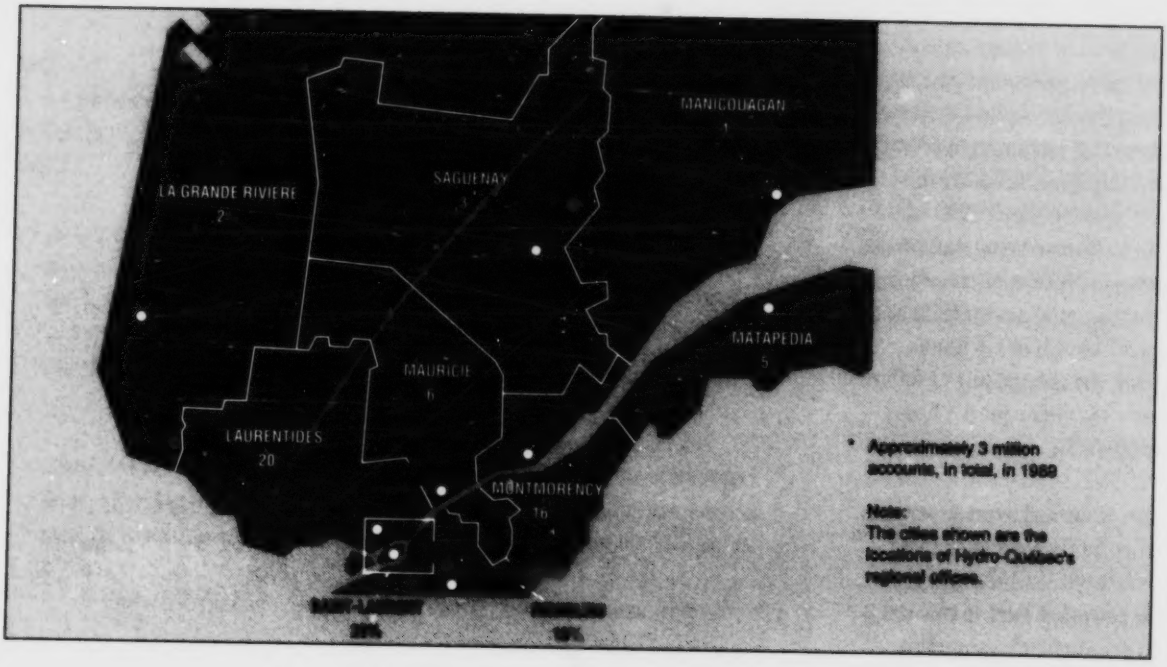
The general improvement in continuity of service noted, (excluding general failures), was also observed in virtually all of the utility's administrative regions.

Map 2.1 shows that more than 80% of Hydro-Québec's customers are located in the *Saint-Laurent*, *Laurentides*, *Richelieu* and *Montmorency* regions.

**Figure 2.1**
Average Annual Service-Interruption Time per Customer by Region*
(Distribution, transmission and sub-transmission, generation)




**Map 2.1**
Percentage Breakdown, by Region, of Customer Accounts*



**By 1995, Hydro-Québec aims to reduce average service-interruption time per customer to 4 hours per year or less, excluding general power failures, a level comparable to the average of other Canadian electrical utilities.**

This average annual service-interruption time per customer can be broken down into 3.5 hours on the distribution system and 0.5 hours on the transmission and sub-transmission systems, excluding general power failures. The utility will be introducing new transmission-system design criteria, among the most stringent in North America, which should reduce to a minimum probability general power failures on the transmission system.

| Objectives | Principal Strategies | |
|---|---|---|
| Average annual customer service-interruption time not to exceed the average of other Canadian electrical utilities by the mid-90s<br>• Distribution: 3.5 hours/year<br>• Transmission and sub-transmission: 0.5 hours/year*<br>• Total: 4.0 hours/year | Distribution | PAQS 2: Service Quality Enhancement Program – Distribution System (1989-1995)<br>Application of new design criteria for the underground system<br>Review of priorities of ongoing activities |
| | Generation, transmission, sub-transmission and telecommunications | PAM: Maintenance Enhancement Program (1989-1996)<br>Implementation of new design and operations criteria for the transmission system (1989-1994)<br>Maintenance of installations nearing the end of their service life<br>System-operation improvement plan |
| | Support activities | Implementation of the new maintenance policy<br>Implementation and ongoing review of integrated quality-assurance management for procurement<br>R&D on equipment reliability and operating methods |

* Excluding general power failures

*2.1.1 Distribution System*

**Present Situation**

*PAQS 2: Service Quality Enhancement Program – Distribution System (1989-1995)*

This program, announced in last year's Development Plan, includes three types of activity:

- renovation of those sections whose level of service continuity is below average, mainly because of age;
- modification of the system to obviate certain safety constraints (addition of grounding equipment, replacement of surge arresters and modifications to facilitate operations on de-energized lines);
- improving the system's operating flexibility (increasing the number of switching points to reduce the number of customers affected by work) and improving component performance.

As part of this program, activities will occur in projects such as the conversion of Montréal and Québec City's outdated underground systems.

A communication program entitled *Hydro-Québec at Your Service* informs the public of system-reliability and service-quality activities that are either scheduled, underway or completed. In addition to explaining these activities, it will also discuss distribution-system improvement work, and enhancement activities conducted on other system components including transmission and generation.

PAQS 2 began in 1989 with various start-up activities, including the hiring of most of the 99 permanent and 117 temporary employees required for the program. A budget of $31 million was allocated to PAQS 2 for 1989. However, with work slowdowns in the context of renegotiation of collective agreements, only $15 million was spent.

*Changing the Priorities for Ongoing Activities*

Besides launching special programs like PAQS 2 and activities related to the growth in demand for electricity such as the addition of distribution lines and connecting new customers, Hydro-Québec is carrying out other activities associated with maintenance of the overhead and underground systems, rehabilitation of facilities, and distribution-system upgrading. In 1989, capital and operating expenditure for the distribution system amounted to nearly $250 million.

The utility emphasized greater productivity in its ongoing activities in 1989 by revising work priorities to reflect the impact on quality of service and giving priority to the 10 sectors with the highest annual service-interruption time, mainly in the *Richelieu, Mauricie* and *Laurentides* regions. It also carried out regional plans of action to solve local problems, such as tree-trimming.

Special reinforcement activities (new underground cables, replacement of overloaded conductors, etc.) were carried out on certain overloaded sections of the system. In 1989, work of this nature cost nearly $83 million, of which $23 million was spent in the *Richelieu* region, mainly on Montréal's South Shore. Moreover, as part of PAQS 2, more than $4 million of reinforcement work was also done, also mainly on the South Shore.

In addition to these prevention activities, the utility improved the efficiency of repairs on de-energized lines.

**Average Annual Service-Interruption Time per Customer Originating on the Distribution System**

The average service-interruption time per customer caused by problems originating on the distribution system dropped from 8.2 hours for 1988 to 5.2 hours for 1989. The utility's goal for March 1990 (6.1 hours) has thus already been exceeded.

**Figure 2.2**
**Average Annual Customer Service-Interruption Time Originating on the Medium-Voltage Distribution System***
**(moving average over 12 months)**

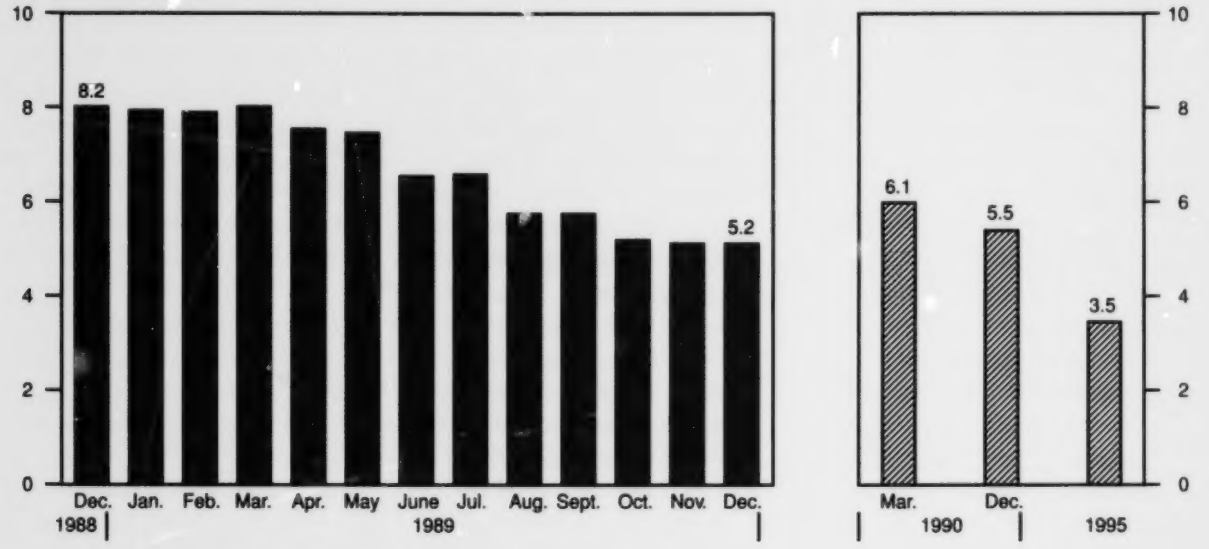
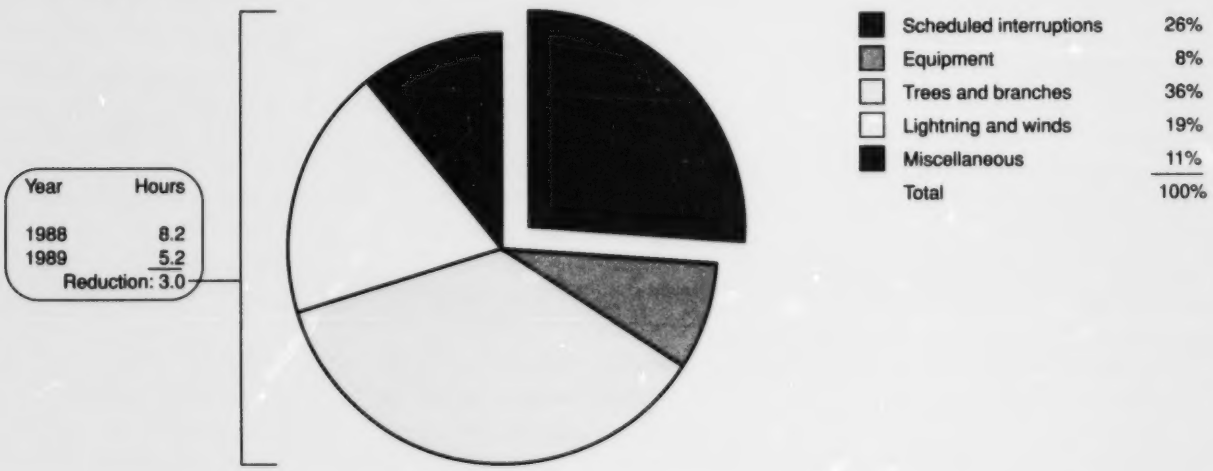



**Figure 2.3**
**Reasons for the Reduction between 1988 and 1989 in Average Annual Customer Service-Interruption Time Originating on the Distribution System**



This 3-hour reduction can be broken down as follows:

- 8% attributable to equipment breakdown. The utility has targeted its activities by giving priority to systems used by the highest population densities and in the most overloaded sectors;

- 36% attributable to trees and branches. The tree-trimming budget was increased to $20 million in 1989 and re-allocated according to the needs of the most problematic areas (mainly the *Laurentides* and, to a lesser extent, *Richelieu* and *Saint-Laurent* regions). Moreover, a new formula was used to assign work, involving granting contracts on a fixed cost rather than an hourly basis. This practice has led to improved productivity. Also, the system benefited in 1989 from less unfavorable climatic conditions than in 1987 and 1988;

- 19% attributable to lightning and winds. Besides the more favorable weather conditions of 1989, the replacement under the PAQS 2 program of some existing equipment by more resistant equipment will make the system less vulnerable to extreme climatic conditions;

- 26% attributable to scheduled interruptions. This reduction was due to better planning of repairs on de-energized lines (consolidated maintenance work) and assigning a larger number of crews to a single job. However, some of this reduction is due to the non-completion of work during renewal of the collective agreements;

- 11% attributable to miscellaneous causes, which group together a number of areas such as corrosion and contamination by sea salt.

**Future Activities involving the Distribution System**

In addition to continuing to assign priorities to ongoing activities, the utility will in coming years carry out the following major programs affecting the distribution system:

*Continuation of PAQS 2: Service Quality Enhancement Program – Distribution System (1989-1995)*

This program, described above, will cost some $707 million over seven years.

**Table 2.2**
Financial Commitments of PAQS 2 Program
(capital and operating expenditure)
(in millions of dollars)

| Type of activity | 1990 | 1991 | 1992 | 1993-1995 | Total* |
|---|---|---|---|---|---|
| System renovation | 41 | 43 | 46 | 154 | 293 |
| Reliability and safety | 9 | 27 | 23 | 18 | 77 |
| System flexibility | 32 | 30 | 29 | 165 | 261 |
| Training | 13 | 13 | 12 | 37 | 76 |
| **Total** | 95 | 113 | 110 | 374 | 707 |

* Including $15 million incurred in 1989.

*Application of New Design Criteria for the Underground Distribution System*

Built over the last 40 years, the underground system is characterized by a large variety of designs and types of construction, configurations and equipment. This requires the development of various kinds of equipment and poses problems for worker safety. Its design must therefore be revised.

Design orientations were prepared in 1989. They will contribute to improving employee safety and service continuity (average annual service-interruption time per customer and average annual frequency of service interruptions per customer).

Before these new design criteria can be applied, the utility will develop technical guidelines on engineering, standardization and equipment certification. It is expected to take three years to finalize these guidelines. Starting in 1993, they will all be implemented on both the existing and new system. Nevertheless, some guidelines will be available before 1993 and may be used for the modifications required on the existing underground system. Nearly $730 million has been projected as the cost of bringing the existing underground system into conformity with the new criteria from 1993 to 2004. The new criteria will also increase the construction costs of the future system by an average 60%, or by nearly $1 billion from 1993 to 2004.

*Remote Control of Lines on the Overhead Distribution System*

Remote control of lines on the distribution system will allow procedures to be executed from the distribution control centres. The opening and closing by remote of equipment (circuit breakers) at strategic points on the system will reduce the duration of scheduled maintenance interruptions as less time would be required for repairs; the same procedures will also allow defective line sections to be more rapidly identified during outages, while limiting the number of customers affected. Remote-controlled equipment is planned for installation at 2,200 strategic switching points in urban and semi-urban environments. This project will require investments in the order of $110 million between 1992 and 1994.

*2.1.2 Generating, Transmission, Sub-Transmission and Telecommunications System*

**Present Situation**

The average annual customer service-interruption time originating from the transmission and sub-transmission system has dropped from 1.8 hours in 1988 to 1.3 hours in 1989 if major power failures are excluded. The major power failure of March 13, 1989, caused by a very intense magnetic storm, lasted on average nearly eight hours. Restoration of power to customers took this long because of equipment breakdowns on the La Grande system, requiring major modifications in the process. As the result of this power failure, the utility's transmission-system operating practices have been modified to ensure the security of the system during magnetic storms.

**Future Activities**

*PAM: Maintenance Enhancement Program (1989-1996)*

This program, which was defined and launched in 1989, contains a series of projects to replace, upgrade, modify and maintain equipment on the generating, transmission, sub-transmission and telecommunications systems. Its goal is to increase the reliability and availability of existing facilities.

For 1990-1992, the utility plans to spend $416 million: $193 million on catching up with maintenance and $223 million to replace and modernize equipment. Nearly $800 million has been projected for expenditure beyond 1992. The final amount will be determined according to the behavior of the system and in light of systematic monitoring of equipment.

*Implementation of New Transmission-System Design and Operating Criteria*

The increasing use of electricity by the utility's Québec customers makes them more dependent on this source of energy and therefore more demanding in terms of the quality of supply.

To reduce to a minimum the probability of general power failures, in 1984 Hydro-Québec began studies to reevaluate its transmission-system design criteria. This re-evaluation however, must be done in conjunction with neighboring systems, given the increasing linkup between them and the Hydro-Québec system.

In the past, when choosing its transmission-system design criteria, Hydro-Québec accepted a higher probability of general power failures than its neighboring systems. The very great distances between the sites where power is generated and used in Québec make the transmission system more vulnerable to the events that can cause a general power failure. Compensating for this higher probability, however, is the fact that Hydro-Québec's power failures are much shorter in duration than those of neighboring systems. Because Hydro-Québec's generating facilities are almost entirely hydroelectric, the system can be restored to service only a few hours after a general power failure, whereas service restoration on neighboring systems using predominantly thermal-fired facilities may require more than a day.

In view of the expectations of Québec customers and to facilitate the integration of its system with neighboring systems in the Northeast Power Coordinating Council, Hydro-Québec decided to aim to raise the reliability of its transmission system to the same level as neighboring systems by 1994. This implies fundamental modifications to the design and operation of the transmission system. In particular, Hydro-Québec will install series compensators throughout the transmission system and shunt reactors, additional reactive compensation and automatic control devices at various substations.

To achieve this goal, an investment program costing in the order of $1,300 million has been planned. This program covers both Hydro-Québec's projects to harmonize its design and operating practices with those of the Northeast Power Coordinating Council, and the utility's previously planned investments to upgrade its transmission system. The engineering and procurement activities for all these projects have begun, and the installation of new equipment will continue until 1994. Nearly $140 million was earmarked in 1989 for this program.

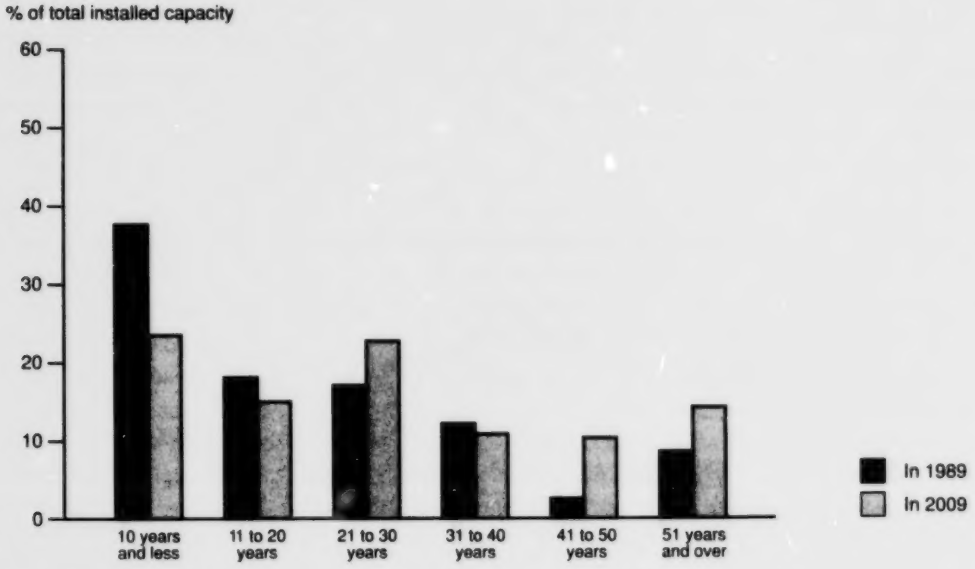
*Maintenance of Existing Installations*

- Generating Facilities

Spending on the renovation of generating facilities has been relatively low thus far as these facilities are relatively new. In 1989, for example, generating stations more than 50 years old accounted for only 9% of total installed capacity. In the years to come, however, the proportion of generating stations approaching the end of their service life will increase, the proportion more than 50 years old reaching nearly 15% in 2009. Some of these facilities are small and medium sized, with capacity not exceeding 200 megawatts. Maintenance for these installations will require increasing attention from the utility.

In order to keep its installations in good working order, Hydro-Québec is focusing on two major approaches: the installation rehabilitation program and major maintenance activities.

**Figure 2.4**
Age of Hydroelectric Generating Units




In order to ensure the maximum availability of its generating facilities, the utility has developed a master rehabilitation plan. Under this plan, work on upgrading or replacing existing generating facilities will cost in the order of $440 million from 1990 to 1992. A five-year schedule of rehabilitation studies has been prepared to reflect the age of the facility, safety and reliability, environmental impact and the likelihood of the outcome being cost-effective.

In 1989, orientation studies recommended upgrading Beauharnois over a nine-year period, at a cost of $1.2 billion. These studies also recommended upgrading La Gabelle and Drummondville generating stations and decommissioning the small L'Anse Saint-Jean station.

Draft-design studies of rebuilding Les Cèdres generating station continued concurrently with the upgrading study for Beauharnois generating station. Studies of Shawinigan-complex, Grand-Mère, La Tuque and Sept Chutes generataing stations and of a few small power plants (Chute Bell, Métis 1 and 2, Rivière-du-Loup, Pont Arnaud and Chute Garneau) will be completed in 1990. These studies use a comprehensive approach that takes into account various solutions for the rehabilitation, reconstruction and removal from service of generating facilities and equipment.

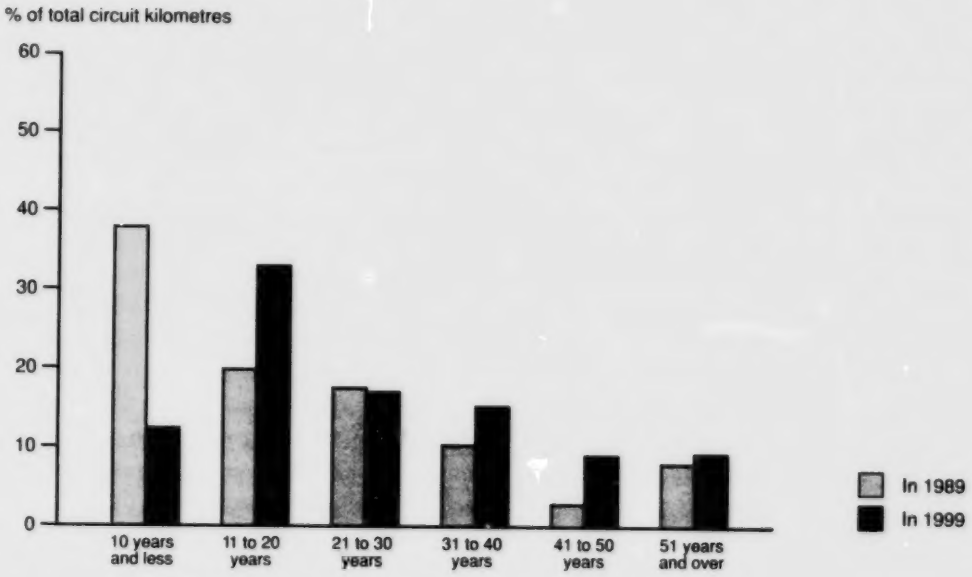
Also, in 1990, new studies of Bryson, Hull 2, Rapide-Blanc and Rivière-des-Prairies generating stations will commence, along with a review of the condition of Tracy thermal generating station to determine its remaining service life.

A total of nearly $475 million will be spent from 1990 to 1992 on major maintenance activities, which mainly involve rebuilding generating units, major work on generators and replacement of turbine runners. The program to replace turbine runners uses new technology to increase efficiency when hydroelectric generating units are upgraded. The program, begun in 1978, aimed to identify units whose rated power could be increased by replacement of their turbine runners. By the end of 1989, an increase of nearly 115 megawatts of power and approximately 200 gigawatthours of energy had been obtained in this way. This replacement program will continue and is expected to result in total gains of 547 megawatts and 400 gigawatthours by 2001, including the upgrading of runners at Manic 5 generating station.

• Transmission System

Although the transmission and sub-transmission system is also relatively new, in the coming years a growing number of components will reach the end of their

**Figure 2.5**
Age of Circuits – Transmission and Sub-Transmission Lines



service life. In the next seven years, Hydro-Québec will replace certain components of its 735-kilovolt system (insulators, spacers and dampers) on about 2,000 kilometres of circuits of first generation lines (Churchill Falls/Manicouagan/Montréal). This is about 20% of the total length of the 735-kilovolt system. The reliability of automatic-control devices and transmission-system protection systems will also be enhanced by replacing various pieces of equipment. As part of its ongoing maintenance activities, Hydro-Québec expects to spend more than $90 million from 1990 to 1992.

The utility also formed a bank of strategic equipment costing $32 million in 1989 to accelerate replacements in case of equipment breakdown, and will continue to purchase additional equipment (transformers, reactors and circuit breakers) at a cost of nearly $100 million between 1990 and 1992.

*System Control and Telecommunications*

The principal function of system control centres and equipment is to continuously monitor changes in important system parameters, such as voltage, power and frequency, and to perform the appropriate operations and adjustments depending on fluctuations in demand. This is only possible because of a complex system consisting of the provincial system control centre, regional control centres, distribution control centres, and a telecommunications control centre.

The utility's determination to improve quality of service requires more efficient management of operations that focuses on reducing the risks of power failures, reducing the impact of maintenance on equipment availability, and restoring service more quickly following interruptions.

The plan for upgrading power-system control covers four key sectors:

- real time operation (addition of personnel following the increase in generating capacity at Manic 5 PA and La Grande 2 A, and the addition of monitoring and protection equipment on the transmission system);
- automation of the regional control centres and the system control centre by installing new software;
- technical support for the regions;
- administrative support (adequate staffing, training).

Spending on the principal programs and projects for the development and optimization of the system-control system is estimated at nearly $120 million from 1990 to 1992. Furthermore, in 1989 Hydro-Québec began a study of modernizing the provincial system control centre. This modernization is planned for 1995.

The utility plans to spend about $75 million on the principal telecommunications programs from 1990 to 1992.

*2.1.3 Forecasts of Expenditures: Principal Generation, Transmission, Distribution and Telecommunications Programs and Projects*

The budgets discussed here are the forecasts for capital and operating expenditures for the principal programs and projects involving the

generating, transmission and sub-transmission, distribution and telecommunications systems.

For 1990-1992, financial commitments directly associated with product-quality enhancement are estimated at nearly $1.9 billion.

Between 1989 and 1996, financial commitments directly associated with product-quality enhancement are estimated at nearly $4.2 billion, compared to $2.3 billion between 1989 and 1998 in last year's Development Plan. The difference can be explained mainly by the various major programs that were referred to in last year's Development Plan but not fully costed: first, the Maintenance Enhancement Program, which represents commitments of about $1.2 billion from 1989 to 1996; and then the implementation of the new underground-distribution-system design criteria, to cost some $0.5 billion by 1996.

**Table 2.3**
Financial Commitments of the Principal Generation, Transmission, Sub-Transmission, Distribution and Telecommunications Programs and Projects
(capital and operating expenditure)
(in millions of dollars)

| **Programs and projects directly associated with enhanced product quality** | | **1990** | **1991** | **1992** | **1990-1992** | **1993-1996** | **Total per project** |
|---|---|---|---|---|---|---|---|
| **Distribution** | PAQS 2 – Service Quality Enhancement Program | 95 | 113 | 110 | 318 | 374 | 707 (1989-1995) |
| | Application of new design criteria to the underground system | 3 | 5 | 8 | 16 | 449 | 465 (1990-1996)* |
| | Remote control of lines | 3 | 0 | 14 | 17 | 96 | 113 (1990-1994) |
| **Generation, transmission and telecommunications** | PAM – Maintenance Enhancement Program | 93 | 143 | 180 | 416 | 785 | 1,208 (1989-1996) |
| | New design and operations criteria for the transmission system | 119 | 381 | 423 | 923 | 437 | 1,367 (1989-1994) |
| | Development and improvement of the telecommunications and system-control systems** | 67 | 78 | 53 | 198 | 143 | 363 (1989-1996) |
| **Total** | | 380 | 720 | 788 | 1,888 | 2,284 | 4,223 |
| **Other programs and projects** | | | | | | | |
| Principal maintenance programs for installations nearing the end of their service lives*** | | 262 | 410 | 438 | 1,110 | | |
| New maintenance policy (monitoring system) | | 7 | 17 | 19 | 43 | | |
| Health, safety, environment, training | | 37 | 26 | 23 | 86 | | |

* Program continuing after 1996: the costs shown are for modifications to the existing system and the increase in costs of the future system
** Includes the system-control enhancement plan
*** Includes the master rehabilitation plan, the principal maintenance programs and the bank of strategic equipment

### *2.1.4 Product-Quality-Enhancement Support Activities*

#### New Maintenance Policy

Hydro-Québec's new approach will make it possible to reduce maintenance activity and thus maintenance costs, and increase equipment availability and thereby improve service continuity.

Experience has shown that it is not always effective to carry out maintenance activities at fixed intervals. From now on, with preventive maintenance based on monitoring, the emphasis will instead be placed on analyzing equipment behavior using sensing devices or sampling. This will enable Hydro-Québec to intervene only when necessary.

Furthermore, the new maintenance policy stresses a system approach, paying as much attention to the status of smaller equipment as to larger facilities where system operation is affected by both.

In order to minimize the impact of equipment unavailable due to maintenance, changes will be made to work organization, including decisions pertaining to scheduling and workshifts, and the introduction of specialized crews.

The utility approved the new maintenance policy in 1989; this calls for the development of automated monitoring systems for generating, transmission and telecommunications equipment, the largest involving monitoring of generating units, circuit breakers and telecommunications equipment. Equipment monitoring projects will cost a total of $125 million by 1996, with $6 million committed in 1989. In 1990, Hydro-Québec will develop the guidelines for implementation of the new policy.

#### Quality Assurance in Procurement

Quality of service also depends on the quality of the equipment installed on the system. Optimal equipment performance cannot be assured without quality integrated into every phase of the equipment life cycle. In addition to playing a role at the design stage, quality assurance must also be implemented during procurement (certification and standardization, qualification of suppliers, factory testing and acceptance testing). The third stage involves installation, operation and maintenance of equipment as well as systematic evaluation of performance, and feedback to suppliers.

*Present Situation*

Major progress has already been made in managing quality assurance in the procurement of generating, transmission, sub-transmission and distribution equipment, given their importance in the system and the costs they generate.

There has been an intensification of efforts involving distribution equipment, for which quality assurance measures have been adopted in the last three years. Accordingly, the installation of all major distribution equipment on the system is now governed by a certification process that requires prior laboratory or power-system testing. A revision of quality control procedures upon acceptance has begun in certain regions as well.

*Future Activities*

For all generating, transmission, sub-transmission and distribution equipment, Hydro-Québec will reinforce reliability by clarifying its expectations of suppliers regarding the quality of purchased products. For manufacturing, Hydro-Québec will stress standardization of its quality control practices among all suppliers of the same kind of equipment and improve its procedures for evaluating both the commercial (on-time delivery, warranty service, after sales service) and technical (compliance with technical and quality-insurance specifications, equipment

performance criteria) performance of suppliers. Improving the quality of procured equipment will require improvement of Hydro-Québec's procedures for coordination and consultation between the parties involved, both within the utility and between the utility and outside suppliers.

The utility will implement specific measures affecting generating, transmission, sub-transmission and distribution equipment.

- Generating, transmission and sub-transmission equipment

Quality control practices during manufacture will be standardized for equipment bought for the regions.

- Distribution equipment

Regarding standardization, Hydro-Québec will begin in 1990 to review all specifications for major distribution system equipment. As part of the application of new design criteria for the underground distribution system, equipment will be certified to improve service quality and job safety.

As part of acceptance testing of procured products, the utility will extend the implementation of revised quality control practices to all regions in 1990.

Furthermore, starting in 1990, Hydro-Québec will develop a data collection system to be able to better analyze the performance of major distribution system components.

**Technology Supporting Quality of Service**

In coming years, R & D will continue to play a crucial role in improving Hydro-Québec's system design, management and operating techniques. A substantial proportion of the R & D activities for generation, transmission and distribution will be focused on improving the productivity and reinforcing the reliability and operating flexibility of equipment. Service quality enhancement alone will account for over three quarters of R & D spending on generation, transmission and distribution from 1990 to 1992, representing $156 million out of a total of $205 million.

**Figure 2.6**
R & D Goals for Generation, Transmission and Distribution
(in millions of dollars)

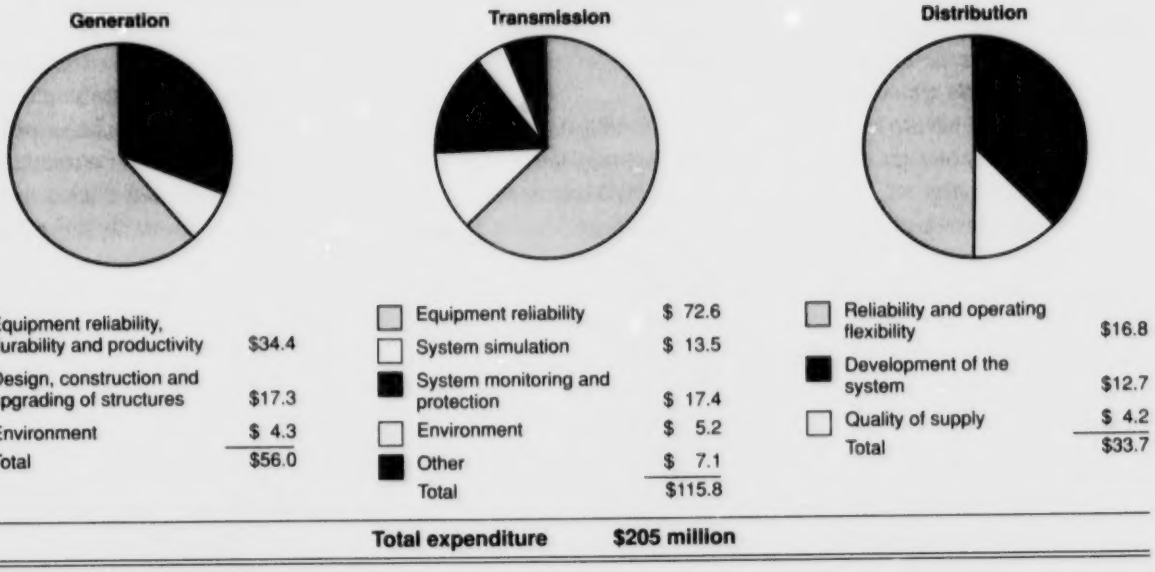



**Table 2.4**
Principal R & D Projects for Generation, Transmission and Distribution (1990-1992)

| Area of Activity | Projects |
|---|---|
| **Generation** | Continuation of installation of the computerized generating-station control system (SICC)<br>Follow-up of generating-unit behavior: manufacture in 1990 of prototypes of the continuous monitoring system for turbine generators (SUPER) |
| **Transmission** | Demonstration of the reliability and performance of high-voltage DC cables (underwater crossing of the Radisson-Nicolet-des Cantons line): tests of cable prototypes and a new 500-kilovolt wall bushing for converter stations<br>Assessment of the prototype line-protection-relay and automatic-control evaluation system (SERA)<br>Simulation of series compensators and appropriate protection systems (new design criteria) |
| **Distribution** | Study of the causes of premature deterioration and aging of certain strategic components of the underground system: diagnosis of joints in 1990, review of equipment procurement specifications starting in 1990<br>Tests of the new explosionproof surge arrester developed by Hydro-Québec |

## *2.2 Quality of Customer Services*

Hydro-Québec seeks to provide a service that meets the expectations of its customers. To achieve this, specific goals will have to be reached gradually over the next three years. This stage will be followed by other measures intended to make Hydro-Québec one of the best performing electrical utilities.

At this time, surveys indicate that overall customer satisfaction has deteriorated. Levels of 92% in 1985 had declined to 59% in January of 1990.

Surveys and information collected from customers indicate that besides power failures, the major causes of dissatisfaction are the following:

- difficulties experienced by customers in reaching the utility's business offices by telephone;
- customers given insufficient notice of scheduled interruptions;
- a portion of bills are issued on the basis of estimated consumption or are not issued at regular intervals in the absence of readings;
- substantial seasonal variations in size of bills of those customers with electric heating.

In addition, some customers complain that it takes too long for service to be connected.

All activities initiated in 1989, and which will continue for the next few years, focus on these principal causes of customer dissatisfaction and are intended to allow Hydro-Québec to equal the performance of the best electrical utilities.

| **Objective** | **Principal Strategies** |
|---|---|
| Enhance customer service quality | Carry out the Service Quality Enhancement Program (PAQS – Clientèle) in order to:<br>• increase the telephone response rate from 73.6% in 1989 to 92% in 1992<br>• systematically inform customers 24 hours in advance of interruptions scheduled to last more than one hour<br>• increase the rate of billings based on actual readings from 83.5% in 1989 to 96% in 1992<br>• increase the equalized-payments-plan saturation rate from 9% in 1989 to 35% in 1992<br><br>Reduce customer-connection-request response times to meet most of the standard for overhead connections by 1991 and the total standard, including underground connections, by 1992 |

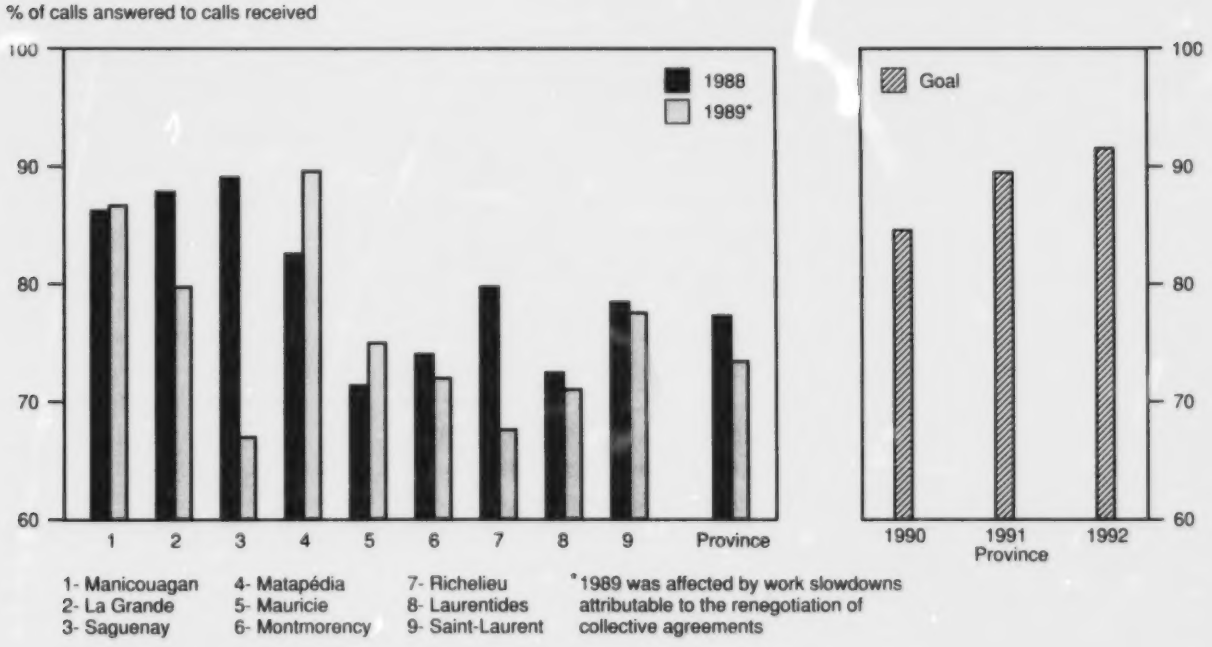
Short- and medium-term activities will focus primarily on the customer service enhancement program, reduced response time for customer connection requests, improved procedures for handling complaints, and modernized collection practices. These activities will require additional resources and better procedures.

**PAQS – Clientèle: Service Quality Enhancement Program – Customer Services**

*Telephone Response Rate*

Hydro-Québec measures its performance in this area by determining the proportion of calls answered to calls received.

**Figure 2.7**
Response Rate to Customer Telephone Calls



The utility increased the number of employees assigned to these tasks in the *Saint-Laurent*, *Laurentides*, *Montmorency*, *Richelieu* and *Mauricie* regions, which had the lowest response rates in 1988 and 1989 (these five regions account for about 90% of Hydro-Québec's customers).

Throughout the province there has been a decrease in the rate of response, falling from 77.5% in 1988 to 73.6% in 1989. Since additional employees were brought in only in the second half of 1989, the response rate in the first six months of 1989 was relatively unchanged from 1988, being about 77%. The results of the last six months reflect the work slowdowns resulting from the renegotiation of collective agreements. The situation worsened in almost all regions.

**In the short term, Hydro-Québec's goal is to raise the response rate to:**

**85% in 1990**
**90% in 1991**
**92% in 1992**

In 1990, Hydro-Québec will complete the installation of a more efficient telephone system in the *Saint-Laurent* region, providing faster access to business offices for customers on the Island of Montréal. Over the medium term, the utility will also revise the work schedules of employees assigned to customer services and introduce new software to acquire and update data on line from customer records.

The other activities under the PAQS – Clientèle program, discussed below, will also help improve the response rate. Increased customer satisfaction should reduce the number of calls received.

*Customer Notification of Scheduled Interruptions*

Information is one means of reducing the dissatisfaction of customers affected by scheduled interruptions, which are required in order to carry out distribution-system enhancements under safe conditions. Hydro-Québec is currently using various methods (media, written notifications, etc.) to alert the largest possible number of customers to scheduled interruptions.

In 1989, to increase the number of customers reached, the utility ran a successful pilot project in the *Laurentides* region using a voice messaging system, which sends pre-recorded telephone messages to customers informing them of work liable to cause service interruptions.

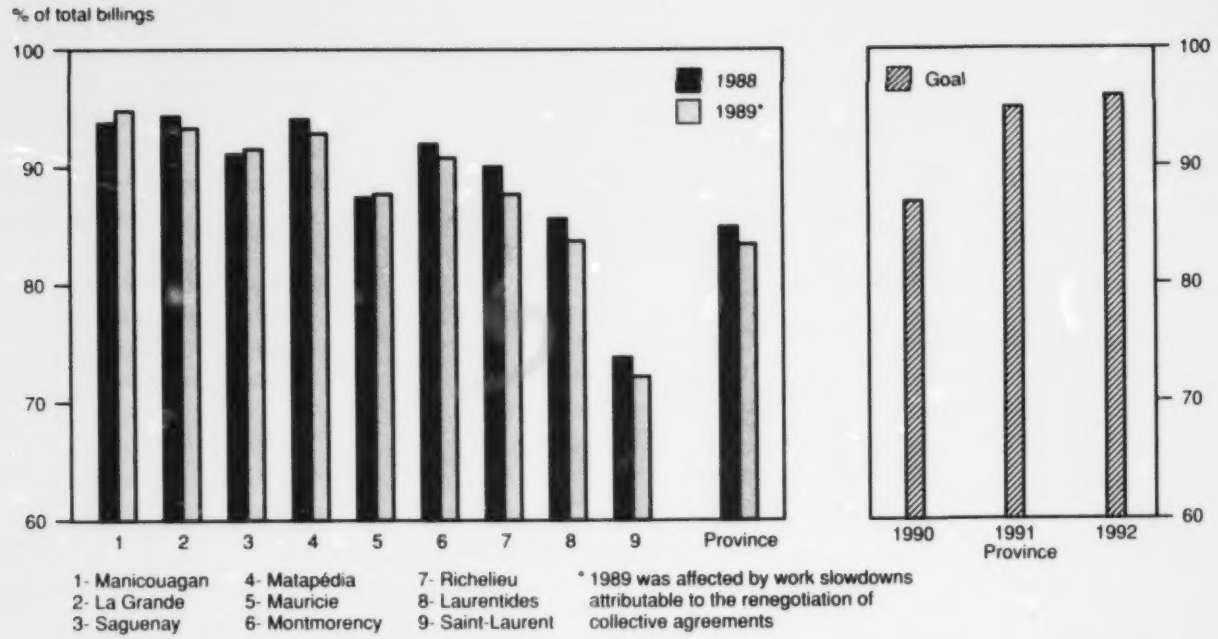
**In 1990, Hydro-Québec intends to systematically inform its customers, 24 hours in advance, of interruptions scheduled to last more than one hour.**

The utility will introduce the voice messaging system into all regions in 1990.

*Increase in the Number of Bills Based on Actual Meter Readings*

Efforts to increase the number of bills based on an actual meter reading encounter two main problems. First, nearly 300,000 meters in Québec are simply hard to get at. This includes about 150,000 meters on the Island of Montréal. More time off for training and intensified measures to improve health and safety have also reduced the real work time of meter readers. In order to reach a new balance between staff levels and the work load, the utility has added appropriate personnel in all regions.

**Figure 2.8**
Rate of Billings Based on Actual Meter Readings




In the province generally, there has been a reduction in the rate of billings based on actual meter readings from 85% in 1988 to 83.5% in 1989, in spite of an increase during the first six months of 1989. In fact, the rate of billing based on actual meter readings had improved from 85% in 1988 to 87% for the first six months of 1989. However, the results for the last six months of the year reflect work slowdowns due to renegotiation of collective agreements.

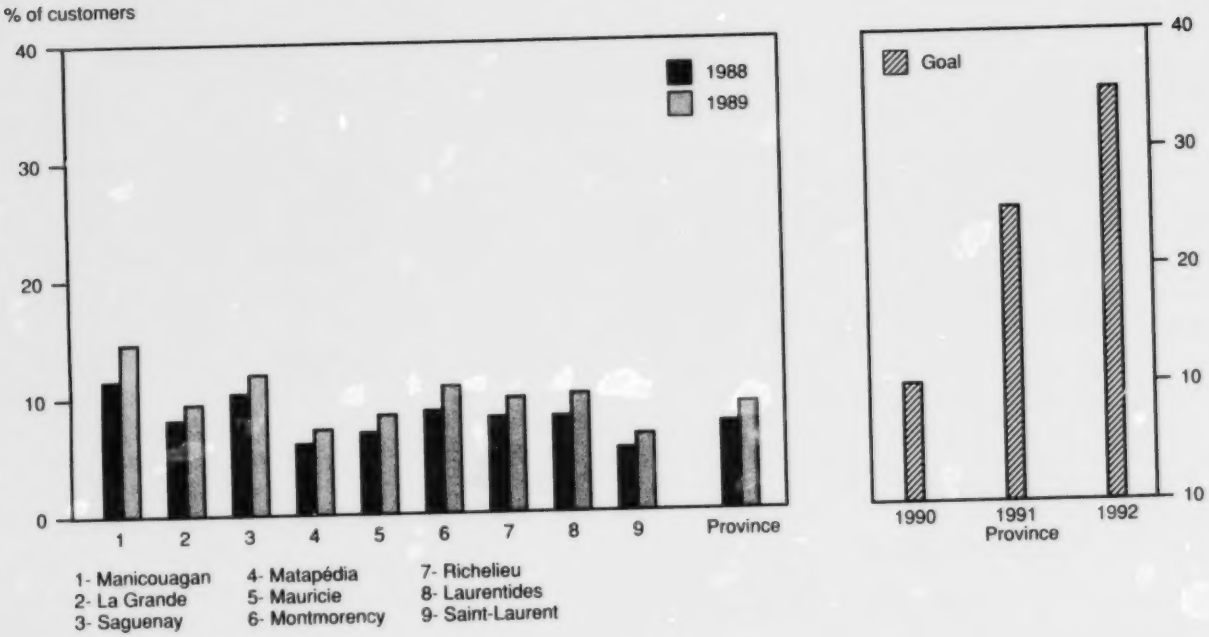
**In the short term, Hydro-Québec's goal is to obtain a rate of billings based on actual meter readings of:**
**87% in 1990**
**95% in 1991**
**96% in 1992**

Between 1990 and 1992, Hydro-Québec will install 100,000 devices on the Island of Montréal using telephone lines to facilitate readings from meters that are difficult to reach, at a cost of nearly $45 million. The remote-reading devices will also improve productivity.

*Variability of Bills*

To deal with the seasonal variability of bills, the utility offers an equalized payments plan, revised on a six-month basis. Hydro-Québec is planning to extend this plan to a larger portion of its residential and commercial customers, while improving its operation. At the same time, the utility has tested an accompanying automatic debit option with a target group of customers in the Shawinigan region.

**Figure 2.9**
Saturation Rate of Equalized Payments Plan




**In the short term, Hydro-Québec's goal is to achieve saturation by the equalized payments plan of:**

**10% in 1990**
**25% in 1991**
**35% in 1992**

Marketing the equalized payments plan to a target group of customers in the Montréal region will begin in early 1990. The utility will then expand its marketing of equalized payments to all regions by the end of 1990 and begin to market automatic debits in 1991.

The following table shows the financial commitments for PAQS – Clientèle based on the evaluation carried out in 1989.

**Table 2.5**
Financial Commitments to Enhance the Quality of Customer Service
(capital and operating expenditure)
(in millions of dollars)

| | 1990 | 1991 | 1992 | Total 1990-1992* |
|---|---|---|---|---|
| **PAQS – Clientèle** | 20 | 41 | 2 | 63* |
| **Other activities** (connections, stray voltages, collection procedures, etc.) | 5 | 4 | 1 | 10 |
| **Total** | 25 | 45 | 3 | 73 |

* In addition to this amount, $4 million was spent in 1989.

**Reduction in Response Time to Customer Connection Requests**

A proposal for a standard specifying corporate objectives on customer connection requests was prepared in 1989. This standard sets a time for carrying out each type of request:

- 7 days for an overhead connection of 120/240 volts, 200 amperes or less without any system modification;
- 40 days for a low-voltage overhead connection requiring system extension or modification;
- 10 days for an underground connection of 120/240 volts, 200 amperes or less without any system modification;
- 70 days for a low-voltage underground connection requiring system extension or modification.

Hydro-Québec has also improved its follow-up system which oversees the progress of connection projects and provides a uniform measurement of completion times.

Hydro-Québec will gradually reduce customer connection times to meet most of the standard by 1991, for overhead connections and the entire standard, including underground connections, by 1992.

**Additional Measures for Better Customer Relations**

*Customer Complaints Procedure*

In January 1989, Hydro-Québec established a formal procedure for handling complaints from all its customers. This procedure allows customers to be heard at three levels of appeal: the sector manager, regional vice president, and president and chief operating officer. Moreover, in 1989, it also set up a complaints management office, reporting to a vice president at head office, for the corporate management of customer complaints. The utility has also added specialized resources to process complaints in business offices serving large numbers of customers.

5,202 complaints were received by Hydro-Québec in 1989. Most of these complaints concerned problems in contacting certain business offices, and commercial practices and billing procedures. In 1989, average complaints-processing time was 18 working days. However, complaints regarding billing procedures, debt collection and commercial practices currently take much longer than average and this situation will be addressed in 1990.

The *Act concerning the treatment of complaints from the customers of electricity distributors* came into force on September 1, 1989. It allows customers who use electricity for residential purposes to apply to a complaints commissioner, appointed by the Québec government and not answerable to Hydro-Québec, for assistance in settling disputes with Hydro-Québec.

Implementation of the Service Quality Enhancement Program – Customer Services (PAQS – Clientèle) and the efforts deployed to upgrade the power system should also help reduce the number of complaints.

*Modernization of Collection Practices*

The greater penetration of the equalized payments plan should facilitate the payment of bills, especially in winter.

The financial losses experienced by Hydro-Québec from unpaid accounts are ultimately borne by all customers. In order to keep the amounts in arrears from becoming inordinately large, the utility will start the collection process earlier. And, in certain instances, more flexible payment formulas will be tried. In 1990, a pilot project in the *Saint-Laurent* region will test revised collection procedures, including spreading the payment of some overdue accounts over 12 months. Implementation of this new procedure throughout the province will depend on test results.

***Program to Assist Farmers in Reducing Stray Voltages***

Hydro-Québec will contribute up to $250 per farm towards an evaluation of electrical installations on farms, to assist in the correction of faulty equipment. This program, initiated by the Québec ***ministère de l'Énergie et des Ressources,*** will initially be limited to dairy and hog farms, under an agreement with the Québec ***ministère de l'Agriculture, des Pêcheries et de l'Alimentation,*** but will be extended to other producers once the causes of the problems and their possible solutions have been identified.

Furthermore, Hydro-Québec will participate with the Canadian Electrical Association in preparing a national protocol for measuring the power quality of distribution systems and their effect on the operation of electronic and other equipment owned by customers. Power quality is a concern shared by all Canadian electrical utilities.

## *2.3 Work Organization, Human Resources and Productivity in Support of Quality of Service*

To meet challenges such as better quality of service, Hydro-Québec will need the total support of all its employees and will work with them to determine the conditions under which these key objectives are attained. Improving the organization of work and providing more training and improved tools are essential to achieving these objectives.

The mobilization of human resources, one of the utility's major concerns, is discussed in Chapter 5 of this Development Plan. Here, only the aspects of training, staffing, work organization and technical improvements directly associated with quality of service are discussed.

The amount of work involved in maintaining an expanding generating system – including installations nearing the end of their service lives that must be updated to improve reliability – will require continuing productivity gains if costs are to be controlled in the long term. The same applies to marketing activities, where the number of customers is increasing and catching-up is also required to achieve better quality of service.

Major gains in productivity have already been achieved in recent years by strategic activities affecting supply, demand and resource rationalization. Now the utility must increase its efforts with respect to human-resources management and work organization. A number of measures in this area have already been introduced and others will be introduced shortly.

### *2.3.1 Generating, Transmission, Sub-Transmission, Distribution and Telecommunications Activities*

#### Training and Staffing

In activities specifically involving generating, transmission, subtransmission, distribution and telecommunications, the utility will intensify training of supervisory managers. To deal with the loss of operators through retirement, a special technical training plan will train the next generation of system-control operators, while the creation of regional trainer positions for the distribution system will help improve employee skills, given the growing technical requirements in this area.

**Work Organization**

The utility has adopted the following priorities:

- when negotiating collective agreements, clarify the provisions involving the exercise of the right to refuse to work for health or safety reasons and the sharing of work between in-house resources and subcontractors, issues currently creating major obstacles to improved productivity;

- add evening shifts to complete work on the Montréal underground distribution system, where automobile traffic constraints substantially reduce available work time. Create a second shift to shorten generating equipment maintenance time;

- improve the quality of supervision by redefining the foreman's role in planning, organization, coordination and control of tasks and provide the support and tools needed for these tasks to be carried out effectively;

- increase the productivity of transmission and distribution line workers and splicers by 30% by 1992;

- implent new maintenance policy guidelines;

- contract out tree-trimming at fixed-price rather than hourly-rate contracts, thereby promoting increased productivity.

**Technical Improvements**

Certain technical improvements contribute to increased short-term efficiency. These include the implementation during 1990 of computerized systems for planning and generating, transmission, sub-transmission and telecommunications work, and systems for scheduling and follow-up of distribution work.

In the longer term, large gains will result from R & D on generation, transmission and distribution, including development of remote control of distribution lines, expert systems, automatic systems for installations monitoring, and robotics.

*2.3.2 Customer Services*

**Training and Staffing**

Permanent and temporary positions of trainers have been added in the regions to satisfy the training needs of the Service Quality Enhancement Program – Customer Services. Among other training-related activities are the development of in-service training programs and classroom training to meet the requirements of certain jobs.

The outside hiring process will also be revised to ensure the quality of candidates and better evaluate their capacity for development.

**Work Organization**

To better respond to customers during peak periods for telephone calls, Hydro-Québec will restructure certain work schedules, and merge certain positions. Furthermore, the utility will seek to relax procedures for filling temporary positions to allow employees already trained in a particular field to receive priority assignment to temporary positions in that field.

**Technical Improvements**

Various improvements in tools will translate into productivity gains. These include remote reading of hard-to-get-at meters and the installation of a computer system allowing service representatives on-line access to customer files. These short- and medium-term activities will constitute the first stage of enhancement of customer-service quality. To make further gains and to improve productivity, the utility will evaluate new technologies available. One study will evaluate the feasibility and usefulness of electronic communications to be more accessible to customers, making it possible for a larger number of customers to receive information during and after business hours on service interruptions affecting them. Interactive voice-messaging systems would make it possible for customers to report meter readings and inform

Hydro-Québec of any changes in their file. Moreover, the use of general-public videotex systems would allow customers to obtain or provide information and submit requests.

## *2.4 Conclusion*

All these steps should lead to better performance in quality of service. However, a prior condition to the successful realization of the objectives outlined in the Development Plan is the setting-up and implementation of negotiated agreements with unionized personnel, which will form the basis of a new consensus on quality of service, productivity and individual aspirations.

In addition, these steps will require a significant increase in human, material and financial resources. While this will mean an increase in the costs of supply, there will be a very marked improvement in quality of service at all levels by the middle of 1990:

- a transmission system that meets the most stringent criteria in North America, with a minimum probability of major power failure;
- a distribution system whose reliability is on a par with Canadian systems facing similar climatic conditions, resulting in a 50 % reduction in interruptions;
- improved customer services to cut to a minimum present causes of dissatisfaction.

**Table 2.6**
Financial Commitments Directly Associated with Service Quality Enhancement
(capital and operating expenditure)
(in millions of dollars)

| | 1990 | 1991 | 1992 | Total 1990-1992 |
|---|---|---|---|---|
| **Product Quality** | 380 | 720 | 788 | 1,888 |
| **Customer service quality** | 25 | 45 | 3 | 73 |
| **Technology** | 52 | 63 | 41 | 156 |
| **Total** | 457 | 828 | 832 | 2,117 |
| including: | | | | |
| - Capital expenditure | 321 | 645 | 682 | 1,648 |
| - Operating expenditure | 136 | 183 | 150 | 469 |

# 3

# SUPPLY AND DEMAND

## *3.1 Hydro-Québec and Sustainable Development*

Various scenarios of economic and demographic growth in Québec, as well as the provincial government's Energy Policy, are used to determine Québec's energy needs. Hydro-Québec's mandate is to meet this demand for electricity. To do this, it must have the flexibility to optimize the comparative advantage that hydroelectricity constitutes for Québec in accordance with the principle of sustainable development.

In 1987, the World Commission on Environment and Development completed work that had started in 1984 and published its final report, *Our Common Future,* which proposed adoption of the principle of sustainable development. The Commission concluded that reducing energy consumption had to be the first method of achieving sustainable development. This is as true for industrialized nations, which must adopt a way of life that respects the planet's ecological limitations, as it is for developing countries, which have tremendous energy needs. Participants in the 14th Congress of the World Energy Conference, held in Montréal in September 1989, expressed their support for these principles.

Following in the footsteps of the federal and Québec governments, Hydro-Québec adopted the principle of sustainable development in 1988 and announced its decision in last year's Development Plan. Hydro-Québec's first contribution to the realization of sustainable development is to promote energy conservation, whatever the demand scenario. Energy conservation is cost-effective for customers, and its integration into strategic planning enables the utility to adapt its Installations Plan and tailor it to Québec's real needs.

Hydro-Québec aims for substantial and realistic energy savings, which must be supported by a rates structure that reflects the cost of supply in order to encourage the rational use of electricity.

The substantial additional revenue generated from the sale of surplus electricity on the Canadian and U.S. markets will benefit all Québecers.

The electricity generated at new facilities brought forward to meet export needs will later be used, when those contracts expire, to meet needs in Québec. In the overall scheme of environmental concerns, the export of hydroelectric energy to neighboring systems could reduce acid rain and the greenhouse effect, which are partly caused by the thermal generating stations operated by these systems. And interconnections developed in this way could bring into Québec energy from neighboring systems, thus reducing the need to build new plant for peak demand.

Québec's economic development over the coming years will partly depend on the long-term availability of a reliable, stable source of energy. Given current concerns about atmospheric pollution and nuclear-waste management, hydroelectricity is a precious asset for Québec.

The province's small and large rivers offer an undeveloped potential of 50,000 megawatts. Studies to date have determined that 18,800 megawatts of this total is economically viable when compared with other generating options such as oil-fired, coal-fired or nuclear plants. Were all this economically viable potential developed, the utility's installations would occupy 2% of Québec in the next century, versus 1% today.

In this Development Plan, Hydro-Québec presents various hydroelectric project proposals, including the Grande Baleine complex, which will meet additional needs towards the end of the century, and the Nottaway-Broadback-Rupert complex, which will meet the needs after the turn of the century.

Sustainable development can be achieved only if companies such as Hydro-Québec incorporate environmental protection and enhancement into their operations, and if they plan their activities on the basis of the environment's ability to support long-term economic development.

It is with this in mind that Hydro-Québec carries out its preliminary studies, impact-assessment studies and environmental evaluations. Moreover, the study of cumulative environmental effects has enabled the utility to analyze the main issues relating to its Installations Plan.

Initial results of the study of cumulative environmental effects show that these developments will not have major effects on the climate, underground water tables, wildlife habitat and resources, and estuarine environments. This first conclusion takes into account the fact that each project will receive a rigorous impact-assessment study and appropriate mitigative measures. Nevertheless, interactions between resources and their users mean that these projects are likely to have significant cumulative effects in three areas of the human environment: organization and structure of the area, regional economies and local lifestyles. Mitigating and managing these effects are possible through an enlarged implementation strategy, focusing on increased collaboration with communities affected, with other land users, and with land-use and resource planners and developers.

Accordingly, in the context of the *Commission parlementaire sur la situation et les perspectives de l'énergie électrique au Québec*, Hydro-Québec welcomes the opportunity for dialogue with government and other interested parties to determine both the market-development choices and the consensus on the advisability of developing the economically and environmentally viable 18,800 megawatts.

## *3.2 Demand for Electricity in Québec*

### *3.2.1 The Year 1989*

In 1989, sales of firm electricity in Québec grew by 7.8 terawatthours, or 6.5% more than in 1988. However, when sales are adjusted to reflect such factors as the weather and strikes in the industrial sector, the rate of growth is closer to 4.6% (5.5 terawatthours), as forecast in last year's Development Plan. This increase is one in a series of years of strong growth of firm electricity sales in Québec, totalling 44 terawatthours, or 52.7% since 1982. Growth in demand in 1989 remains nevertheless moderate compared to the increase in sales recorded in 1988 (9.4 terawatthours).

The greatest portion of the growth comes from the residential and farm, general and institutional sectors, due mainly to the demand for all electric and dual-energy heating. The all-electric heating market posted growth of more than 2.8 terawatthours, or 36% of firm Québec sales, mainly in the residential sector, with 48,000 housing starts in 1989. Although this reflects slowing new construction, growth in consumption of electric heating is still being carried by the housing starts of 1988 (58,000).

Dual-energy programs continue to be a major source of growth, contributing 1.6 terawatthours or 21% of the increase in demand in 1989. The dual-energy program in the commercial, institutional and industrial sector accounts for almost all of the increase. Although this program ended in June 1988, customer connections carried out in 1989 pushed sales of dual-energy heating to their current level.

The 3.9-terawatthour increase in 1989 in the residential and farm sector must, however, be placed in perspective. If extraordinary events are factored in, the 1989 increase is about 1.5 terawatthours, compared to adjusted growth in 1988 of 3 terawatthours. The particularly cold spell at the end of 1989 alone accounts for 1.8 terawatthours of the increase recorded in this sector.

Consumption of electricity in the industrial sector posted a rather modest increase of 1.7 terawatthours in 1989 or 22% of increased demand, after the strong rise of more than 3.0 terawatthours recorded in 1988. Production levels remained high, especially in industries that are heavy consumers of electricity, while consumption by other industries showed signs of weakening.

Two industrial sectors stand out: pulp and paper, where continued modernization helped increase electricity consumption by 0.3 terawatthours, in spite of a drop in newsprint output, and smelting and refining, where the level of aluminum production stabilized. Moreover, a new sector, magnesium, began to make itself felt.

Although sales of firm electricity increased by 7.8 terawatthours in 1989, the almost total halt in sales of surplus energy by the utility explains why total sales of electricity in Québec fell by 0.6 terawatthours compared to 1988.

**Table 3.1**
Sales of Electricity by Hydro-Québec in Québec – Average Scenario
(in terawatthours)

| | 1988 | 1989 | Growth | 1990 | 1991 | 1992 | 1996 | 1999 | 2006 |
|---|---|---|---|---|---|---|---|---|---|
| **Residential and farm sector** | 43.7 | 47.6** | 3.9 | 46.8 | 47.0 | 47.5 | 49.7 | 50.6 | 53.0 |
| **General and institutional sector** | 26.6 | 28.8 | 2.2 | 26.5 | 29.0 | 29.4 | 30.5 | 31.8 | 35.0 |
| **Industrial sector** | 44.8 | 46.5 | 1.7 | 48.0 | 53.4 | 57.5 | 69.7 | 77.0 | 84.7 |
| **Other** | 4.7 | 4.7 | 0.0 | 4.9 | 4.9 | 4.9 | 5.3 | 5.7 | 6.5 |
| **Sales of firm electricity in Québec made up of:** | 119.8 | 127.6** | 7.8 | 126.2 | 134.2 | 139.4 | 155.1 | 165.1 | 179.3 |
| • residential dual energy | 0.7 | 0.8 | 0.1 | 1.0 | 1.2 | 1.4 | 1.4 | 1.4 | 1.3 |
| • CII dual energy* | 3.3 | 4.9 | 1.5 | 1.4 | 4.1 | 4.1 | 3.8 | 3.7 | 3.3 |
| • electrotechnologies | 0.4 | 0.9 | 0.4 | 1.4 | 1.6 | 1.8 | 3.1 | 4.2 | 5.7 |
| **Sales of surplus electricity in Québec** | 8.7 | 0.3 | –8.4 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Sales in Québec** | 128.5 | 127.8 | –0.6 | 126.2 | 134.2 | 139.4 | 155.1 | 165.1 | 179.3 |

* Commercial, institutional and industrial dual energy.
** Cold weather in late 1989 alone accounts for 1.8 terawatthours of the increase in the residential and farm sector, or 2.2 terawatthours for all firm-electricity sales in Québec.

### *3.2.2 The Long Term*

**Average-Demand Scenario**

Gross demand for firm electricity in Québec will grow on average by 2.6% between 1989 and 2006, to reach nearly 200 terawatthours. Taking into account the impact of energy conservation, growth in sales of firm electricity in Québec will be 2.0% between 1989 and 2006 in the average-demand scenario. Energy conservation reduces needs for firm electricity by nearly 19 terawatthours, or 10%, giving total sales of 179.3 terawatthours in 2006. On the 1999 horizon, counting on energy conservation of 12.9 terawatthours, or just over 7% of sales, total sales will reach 165.1 terawatthours.

Energy conservation has two components: natural efficiency and efficiency promoted by Hydro-Québec's action programs and rates.

Natural efficiency, the first component of energy conservation, comes about when the various economic agents change their consumption of electricity, independent of any special energy-conservation incentive. It requires only minimal intervention on the part of Hydro-Québec or government but it does however require the continuation of past efforts. Natural efficiency affects heating and consumption by household appliances in the residential and farm sector, as well as captive and competitive uses in the general and institutional sector. The penetration of new heating techniques, such as heat pumps, improved insulation during renovation and the replacement of old appliances all tend to reduce the consumption of electricity. The efficiency gained from this source is estimated to be 3.9 terawatthours in 1999 compared to 1989.

Indeed, an evaluation of natural efficiency in the industrial sector was implicitly included in demand forecasts. Some new production techniques consume less electricity. For example, the new aluminum smelters consume 15% less per tonne than older facilities. On the other hand, some new production techniques consume more electricity. In the pulp and paper industry, for example, new processes which conserve wood fibre can consume twice as much electricity as old ones. Moreover, Québec industry in general is more electrified, partly due to electrotechnologies, partly due to investments in pollution-control equipment, but the scale of this phenomenon remains difficult to quantify.

Energy conservation stimulated by Hydro-Québec's rates structure and programs is the second component of reduced demand. A number of price signals will be sent to customers in coming years: increases in electricity rates that exceed inflation, the federal tax on goods and services charged to residential customers, and reduction of cross-subsidization among various customer categories. Hydro-Québec will also introduce special programs to promote energy conservation in all sectors. These programs and the price signals will mutually reinforce each other over the next few years and should result in more efficient use of and reduced demand for electricity (9.0 terawatthours in 1999). Energy-conservation programs are discussed in detail in section 3.4.

In addition to energy conservation, demand forecasts reflect a number of significant new elements compared to last year. By 1996, new aluminum smelters will require 850 megawatts (5.2 terawatthours) more than forecast in last year's Development Plan. Aluminum smelters supplied by Hydro-Québec will consume nearly 2,300 megawatts (18.3 terawatthours) in this horizon; with Alcan and Canadian Reynolds Metals, the total will exceed 4,000 megawatts. Moreover, an upward revision in the number of new households (an additional 112,000), reflecting a change in the number of households for 1986, and a forecast of higher net immigration, add 2.0 terawatthours to forecasts for 2006.

On the other hand, dual-energy sales in the commercial, institutional and industrial sector have been revised downward. A detailed analysis of competition from other sources of energy has accelerated the projections of long-term erosion of this market. And the temporary halt to this program, as a result of low runoff, will allow the buyback of nearly 4.0 terawatthours of energy in 1990.

Demand forecasts are influenced in the short term by the economic situation. Québec's economy entered a slowdown in 1989, with real growth in the gross domestic product (GDP) of 2.2%, compared to 5.4% in 1988. This slowdown should continue. The average-growth scenario assumes a real increase in the GDP of 1.7% in 1990 and 2.2% in 1991. Lower consumption by individuals and reduced residential investments account for most of this change. However, non-residential investment will support economic growth during these years.

In conclusion, in the average – demand scenario, growth in demand for electricity in Québec will average 2.8% between 1989 and 1996, and 1.5% between 1996 and 2006. This represents a 2.0% growth for the total period 1989 to 2006.

A detailed description of the assumptions involved in the demand forecast is presented in a separate publication entitled *Electricity Demand in Québec*.

**Table 3.2**
Average Annual Growth of Firm-Electricity Sales in Québec – Average Scenario
(in %)

| | 1989-1996 | 1996-2006 | 1989-2006 |
|---|---|---|---|
| **Residential and farm sector** | 0.6 | 0.6 | 0.6 |
| **General and institutional sector** | 0.8 | 1.4 | 1.2 |
| **Industrial sector** | 5.9 | 2.0 | 3.6 |
| **Other** | 1.8 | 2.1 | 1.9 |
| **Firm sales in Québec made up of:** | 2.8 | 1.5 | 2.0 |
| • residential dual energy | 8.3 | –1.2 | 2.6 |
| • CII dual energy* | –3.5 | –1.6 | –2.4 |
| • electrotechnologies | 20.2 | 6.3 | 11.8 |

* Commercial, institutional and industrial dual energy.

### Uncertainties

The scenarios of strong and weak demand, based mainly on opposing hypotheses of demographic and economic growth, flank the average demand scenario. In the strong-demand scenario, demand in Québec increases at an average annual rate of 2.6% between 1989 and 2006, while the weak-demand scenario is based on average growth of 1.1%.

The strong-demand scenario incorporates more energy conservation than the average-growth scenario because pressure on the costs of supplying electricity to meet strong demand would systematically raise the rates, thus increasing the potential for energy conservation. So special programs and rates could generate 15.5 terawatthours of savings on the 1999 horizon.

In the weak-demand scenario, energy conservation is less present because of lower supply costs and weaker demand, and energy savings would be 7.4 terawatthours on the 1999 horizon.

**Figure 3.1**
Scenarios of Evolution of Firm Electricity Sales by Hydro-Québec in Québec

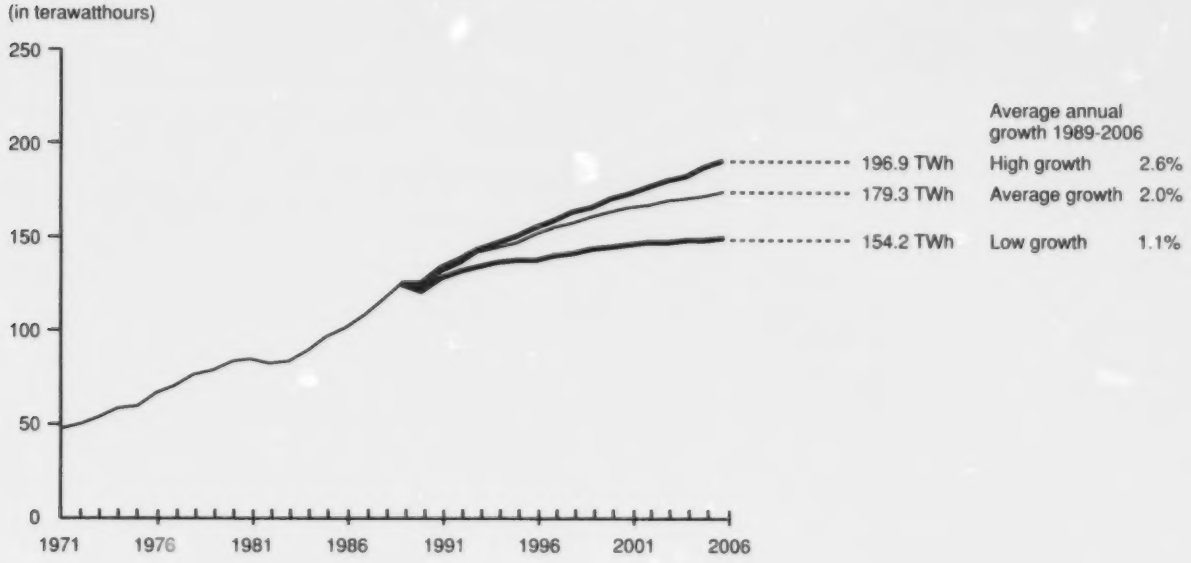



**Table 3.3**
Average Annual Growth Rate of Demographic and Economic Indicators in Québec
(in %)

| | Strong-Demand Scenario | | Average Scenario | | Weak-Demand Scenario | |
|---|---|---|---|---|---|---|
| | 1989-1996 | 1996-2006 | 1989-1996 | 1996-2006 | 1989-1996 | 1996-2006 |
| New households | 2.1 | 1.5 | 1.7 | 1.1 | 1.2 | 0.6 |
| Total GDP* | 3.1 | 2.9 | 2.6 | 2.3 | 1.6 | 1.6 |
| GDP* of the manufacturing sector | 3.3 | 2.9 | 2.6 | 2.2 | 1.4 | 1.4 |
| GDP* of the service sector | 3.2 | 2.9 | 2.7 | 2.4 | 1.9 | 1.8 |

* Gross domestic product in constant 1981 dollars.

Variations in the consumption of electricity can cause reality to diverge from long-term planning scenarios for relatively long periods in all three sectors of consumption.

In the residential and farm sector, demand for electricity could be higher than forecast if the rate of conversion from fuel oil to electricity continues to be fast. Conversely, the use of more efficient household appliances could accelerate. The federal tax on goods and services could cause a major shift away from forecast behavior. And average electricity demand for home heating might also develop differently as residential customers change their consumption patterns.

The general and institutional sector could experience lower consumption of electricity than in the average-demand scenario if penetration by heat pumps is higher. However, potential modifications to ventilation standards for office buildings and commercial premises would increase electricity demand.

Consumption by the industrial sector could be affected by the timing and rate of start-up of large-power industries. The nature and rate of anti-pollution investments and electricity-intensive industrial processes could also increase demand.

Given these uncertainties, Hydro-Québec must have a great deal of flexibility in its methods of adapting to supply and demand fluctuations.

**Table 3.4**
Firm-Electricity Needs To Be Met
(in terawatthours)

| | 1988 | 1989 | 1990 | 1991 | 1992 | 1996 | 1999 | 2006 |
|---|---|---|---|---|---|---|---|---|
| **Strong-Demand Scenario** | | | | | | | | |
| Firm-electricity sales in Québec | 119.8 | 127.6 | 128.3 | 136.7 | 141.5 | 159.3 | 170.7 | 196.9 |
| Needs to be met* | 163.7 | 157.0 | 158.9 | 169.2 | 174.5 | 196.1 | 211.9 | 246.2 |
| **Average Scenario** | | | | | | | | |
| Sales of firm electricity in Québec | 119.8 | 127.6 | 126.2 | 134.2 | 139.4 | 155.2 | 165.1 | 179.3 |
| Sale of surplus electricity in Québec | 8.7 | 0.3 | 0 | 0 | 0 | 0 | 0 | 0 |
| Deliveries as per agreement in Québec** | 4.1 | 5.5 | 4.7 | 4.4 | 4.3 | 4.2 | 3.1 | 3.1 |
| Export sales of firm electricity | 9.2 | 8.8 | 11.6 | 12.6 | 12.8 | 15.2 | 19.3 | 24.5 |
| Export sales of surplus electricity | 7.7 | 0.9 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total deliveries | 149.5 | 143.1 | 142.4 | 151.2 | 156.5 | 174.5 | 187.5 | 206.9 |
| Electrical losses relative to these sales | 14.2 | 14.1 | 14.3 | 15.1 | 15.6 | 17.1 | 18.3 | 20.0 |
| **Needs to be met** | 163.7 | 157.0 | 156.7 | 166.4 | 172.0 | 191.6 | 205.8 | 226.9 |
| **Weak-Demand Scenario** | | | | | | | | |
| Sales of firm electricity in Québec | 119.8 | 127.6 | 124.7 | 131.7 | 135.3 | 142.3 | 147.6 | 154.2 |
| **Needs to be met*** | 163.7 | 157.0 | 155.1 | 163.5 | 167.6 | 177.5 | 186.5 | 199.2 |

* Deliveries as per agreement and export sales of firm electricity are identical to those in the average scenario.
** Deliveries as per agreement includes the electricity that Hydro-Québec supplies for compensation other than payment.

## Power Needs of the Average-Demand Scenario

Priority power requirements correspond to the annual peak demand on Hydro-Québec's system. This projected demand is 35,300 megawatts in 1999 and 38,550 megawatts in 2006, for an average annual growth rate of 2.1% between 1989 and 2006.

This forecast takes into account integrated measures that will reduce demand by about 4,130 megawatts in 1999. They include peak shaving of dual-energy systems and the impact of energy-conservation programs on power demand. Moreover, with respect to industrial markets, in 1996 the utility will have 1,200 megawatts of potential interruptible power to meet peak demand. These management measures will total more than 5,300 megawatts in 1999 and 6,000 megawatts in 2006, or more than 16% of needs to be met.

**Table 3.5**
Impact of Management Measures and Energy Conservation on Power Needs – Average Scenario
(in megawatts)

| | 1988** | 1989 | 1990 | 1991 | 1992 | 1996 | 1999 | 2006 |
|---|---|---|---|---|---|---|---|---|
| **Peak-demand management measures** | | | | | | | | |
| Dual-energy peak shaving | 1,700 | 1,810 | 1,890 | 2,060 | 2,190 | 2,060 | 1,990 | 1,830 |
| **Impact of direct measures and rates on energy conservation** | 0 | 0 | 0 | 460 | 670 | 1,590 | 2,140 | 3,020 |
| **Total** | 1,700 | 1,810 | 1,890 | 2,520 | 2,860 | 3,650 | 4,130 | 4,850 |
| **Priority needs*** | 26,466 | 27,045*** | 29,070 | 29,750 | 31,010 | 33,440 | 35,330 | 38,550 |
| **Peak-demand management measures** | | | | | | | | |
| Interruptible power | 675 | 783 | 850 | 1,000 | 1,050 | 1,200 | 1,200 | 1,200 |
| **Needs to be met** | 25,791 | 26,262 | 28,220 | 28,750 | 29,960 | 32,240 | 34,130 | 37,350 |

* Includes dual-energy peak shaving as well as the impact of energy-conservation programs.
** Winter peaks beginning in December of the year indicated.
*** Peak occurring on December 14, 1989 at 5:00 p.m.

## Comparison with the 1989-1991 Development Plan

In the long term, the net variation in firm sales predicted for 1999 between the 1990-1992 and the 1989-1991 Development Plans is 4.9 terawatthours. This is due to increased demand from new aluminum smelters in Québec and an upward reassessment of demographic trends.

In addition to the assumptions related to a reduction of cross-subsidization and natural energy efficiency discussed in the 1989-1991 Plan, the 1990-1992 Plan factors in additional energy conservation, attributable to the combined effects of direct-intervention programs and from rate increases above inflation. All these measures reduce somewhat the increase in demand.

**Table 3.6**
Comparison of the 1989-1991 and 1990-1992 Plans – Sales of Firm Electricity in Québec – Average Scenario
(in terawatthours)

| | 1989 | 1990 | 1991 | 1992 | 1996 | 1999 | 2006 | Growth 1989-2006 (%) |
|---|---|---|---|---|---|---|---|---|
| 1989-1991 Plan | 125.3 | 130.1 | 134.4 | 137.7 | 151.0 | 160.2 | 175.3 | 2.0 |
| 1990-1992 Plan | 127.6 | 126.2 | 134.2 | 139.4 | 155.2 | 165.1 | 179.3 | 2.0 |
| Difference | 2.2* | –3.9 | –0.2 | 1.7 | 4.2 | 4.9 | 4.0 | |

* The forecast in the 1989-1991 Development Plan was based on normal weather conditions and average runoff. Thus the variation of 2.2 terawatthours in relation to the actual 1989 situation is related to colder weather in 1989 and the temporary buyback in 1990 of commercial, institutional and industrial dual-energy contracts.

## *3.3 Short-Term Supply-and-Demand Review*

| Objective | Strategies |
|---|---|
| Medium-term planning of power-system operation to be in a position to cope with extreme variations in water inflows | Re-establish reserve levels in the reservoirs; maintain, manage and develop methods of supply-and-demand management according to runoff cycles |

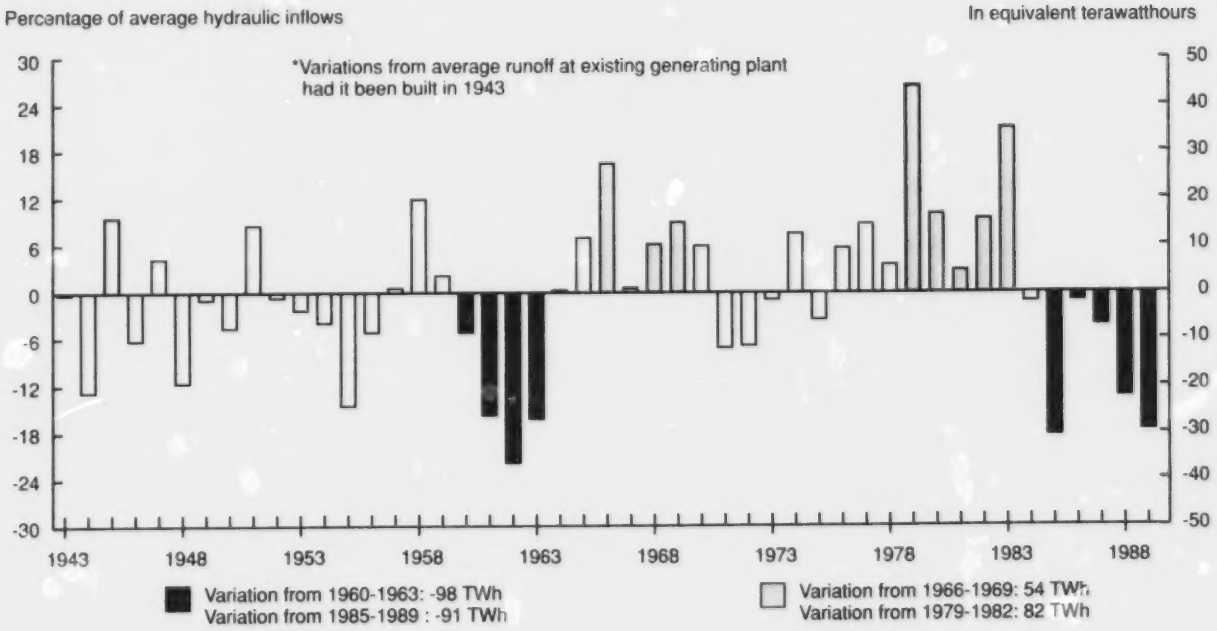
### *3.3.1 Energy*

#### Inflows

Hydro-Québec's generating facilities are 95% hydroelectric, and they depend on available inflows. If runoff in 1990 is average, energy inflows at the hydroelectric generating stations, including Churchill Falls, should total 165.5 terawatthours.

This figure is 2.9 terawatts below that given in last year's Development Plan and was obtained by the more accurate establishment of inflows from all Québec watersheds and an update of historical data over the 46-year period from 1943 to 1988, rather than 1949 to 1979, for all watersheds including that of Churchill Falls. Recent years of low runoff account for 25% of this downward revision.

**Figure 3.2**
Historic Variation of Inflows*



Variability of inflow is illustrated in Figure 3.2. Records indicate that inflow levels can vary substantially from year to year. For example, 1962 had 36 terawatthours less than average, and 1979 had 44 terawatthours more than average. From 1960 to 1963 inclusively, the maximum accumulated difference was 98 terawatthours below average, while from 1979 to 1982 it was 82 terawatthours above average.

Since 1985, the accumulated inflow deficit has totalled 91 terawatthours, or more than 70% of total sales in Québec in 1989. This period of low runoff has seen the second largest deficit in the past 25 years.

**Inflow Risk Management**

In normal circumstances, inflows are adequate to meet demand. However, there can be major variations, upward or downward. Hydro-Québec has large storage reservoirs in which it can either store water reserves or draw from these reserves in times of low runoff. Nevertheless, the size of these reservoirs is limited by economic and environmental factors. So Hydro-Québec must have recourse to measures other than hydroelectric in order to manage its energy reserve. This is always factored into short-term operations planning and long-term facilities planning.

Reserves are composed of a seasonal reserve and a multi-annual reserve. Seasonal reserve offsets low winter inflows when demand is high because of widespread electric heating.

The multi-annual reserve tops up the seasonal reserve. It stores surplus inflows in years of high runoff in readiness for years when runoff is lower than average. Given the limited size of reservoirs, sales of surplus electricity must be made in years of high runoff if spillage is to be avoided.

Conversely, in years of low runoff, the size of reservoirs renders water reserves alone insufficient. So exceptional non-hydroelectric measures must be taken to avoid load-shedding. In addition to halting surplus-electricity sales, these measures are, in increasing order of cost: operation of Tracy thermal generating station, off-peak purchases from neighboring systems, dual-energy buyback, and purchases from neighboring systems during their peak periods.

Exceptional measures must be economic and preventive. They have to be introduced well before an imminent spillage or drying-up of reservoirs. Therefore Hydro-Québec must maintain an adequate reserve, taking into account the cost and availability of these exceptional measures.

**Exceptional Measures**

As shown in Figure 3.3, the utility was only slightly affected in 1985 and 1986 by low runoff levels, as it continued to have a generating surplus arising from the 1981-1982 recession and the heavy runoff from 1976 to 1983. However, persistent low runoff since 1984 and an exceptionally strong economy caused Hydro-Québec to begin a number of actions that had been described in earlier Development Plans in the event of low runoff.

The first series of actions in 1988 comprised gradually halting surplus-electricity sales. In its second series of actions, Hydro-Québec instituted exceptional measures in 1988 and 1989 to restore its energy reserves in the most cost-effective way. These measures consisted of purchases from neighboring systems during non-peak periods; operation of Tracy thermal generating station as a base-load facility; and the buyback of commercial, institutional and industrial dual-energy contracts.

Using only the least expensive exceptional measures in 1990 and 1991, the utility could cope with two additional years of low runoff equivalent to the two worst years of its history: a deficit of 65 terawatthours compared to average runoff years. Recourse to more expensive additional measures would allow the utility to deal with a period of low runoff in the next four years equivalent to the four worst years of its history. However, there is very little likelihood of its having to do so.

**Figure 3.3**
Evolution of the Usable Reserve – Average Scenario with Extremes of Inflow

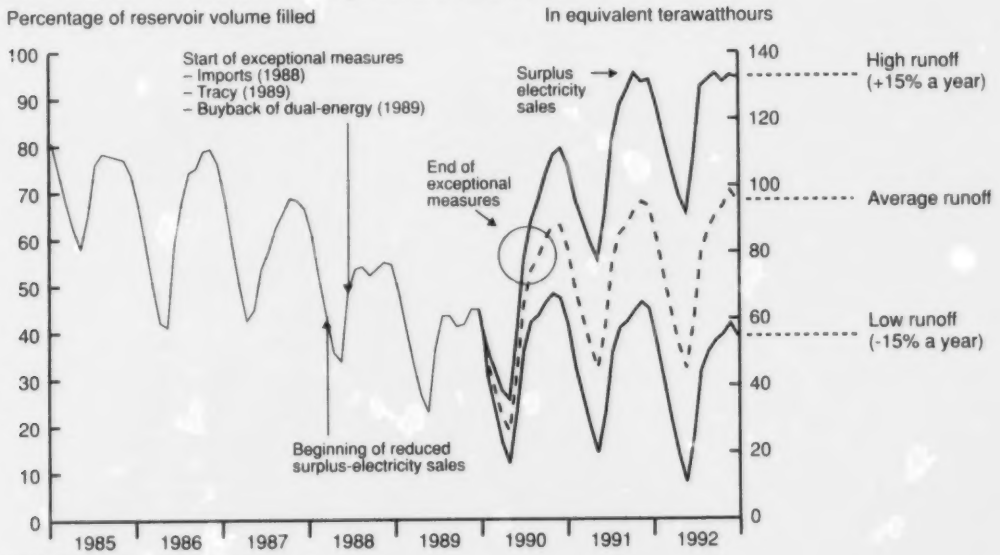



**Table 3.7**
Exceptional Measures to Ensure Energy Reserves
(in terawatthours)

| | Measures Used | | Additional Measures Available But Not Implemented | |
|---|---|---|---|---|
| | 1989 | 1990 | 1990 | 1991 and after |
| Buybacks of contracts and CII* dual-energy rates maintained at high levels | 0.3 | 3.8 | | 3.6 to 3.9 |
| Purchases from neighboring systems | 3.5** | 3.5 | 4 to 5 | 7 to 8 |
| Tracy | 1.4 | 2.6 | – | 3.4 |

* Commercial, institutional and industrial dual energy.
** Does not include about 0.5 terawatthours of energy obtained from purchases of power in 1989.

**Table 3.8**
Electrical-Energy Balance Sheet – Average Runoff
(in terawatthours)

| | 1990 | 1991 | 1992 |
|---|---|---|---|
| **Supply** | | | |
| Hydroelectric generation | | | |
| • inflows* | 164.4 | 165.6 | 166.0 |
| • Gentilly 2 | 4.9 | 3.7 | 5.0 |
| • isolated systems | 0.2 | 0.2 | 0.3 |
| Receipts under agreement and contractual purchases | 3.9 | 4.0 | 4.9 |
| Exceptional measures | | | |
| • Tracy | 2.6 | 0.0 | 0.0 |
| • imports | 3.5 | 0.0 | 0.0 |
| **Total** | **179.5** | **173.5** | **176.2** |
| **Demand** | | | |
| Priority needs – Québec | 144.5 | 153.1 | 158.5 |
| Export sales of firm electricity and associated losses** | 12.1 | 13.3 | 13.5 |
| **Total** | **156.7** | **166.4** | **172.0** |
| **Difference between supply and demand** (generation margin used to fill reservoirs) | **22.8** | **7.1** | **4.2** |

* Corresponds to average inflows including Churchill Falls. The values reflect variations in the heads of generating stations caused by reservoir filling and improvements to existing installations.

** Includes 0.6 terawatthours of interconnection testing.

### *3.3.2 Power*

To be able to reliably satisfy peak power needs, it is necessary to set aside a power reserve to take into account possible variations in demand due to climatic and economic conditions, and also to provide a reserve to reflect the unavailability of certain equipment.

This power reserve comprises the following options, ranging from the least to most expensive: hydroelectric facilities available at peak periods, thermal generating facilities, purchases of power from neighboring systems, and interruptible power.

Because of the rapid growth in demand, 1990 to 1992 will be characterized by a slight deficit in the required power reserve, even with the addition of gas turbines with a capacity of about 800 megawatts at La Citière and Bécancour.

Before construction of the next peak-load facilities in 1992 and 1993, the utility can use exceptional operating measures for maintaining the system's power reserve. These include additional purchases of power from neighboring systems, special agreements with industrial customers and, as a last recourse, the application of measures to increase the capacity of certain generating stations for short periods. These exceptional measures would result in 300-500 megawatthours of increased output, not including recourse to voltage reductions.

**Table 3.9**
Power Balance Sheet
(in megawatts)

| | 1990-1991 | 1991-1992 | 1992-1993 |
|---|---|---|---|
| **Supply** | | | |
| – Existing plant** | 24,820 | 24,910 | 24,950 |
| – Various improvements and additions | 50 | 1,050 | 2,610 |
| – Purchases and sharing of reserve | 6,540 | 6,580 | 6,690 |
| **Total** | 31,410 | 32,540 | 34,250 |
| **Demand** | | | |
| – Priority needs | 28,220 | 28,750 | 29,960 |
| – Exports | 470 | 600 | 770 |
| – Isolated systems | –50 | –50 | –60 |
| **Total** | 28,640 | 29,300 | 30,670 |
| **Balance** | | | |
| – Supply and demand | 2,770 | 3,240 | 3,580 |
| – Required reserve | –3,110 | –3,500 | –3,890 |
| **Surplus, deficit (-) in relation to required reserve** | –340* | –260* | –310* |

* Temporary operating measures affecting 300 to 500 megawatts are available to manage these power deficits.
** Includes Tracy and Gentilly 2 generating stations. The power available increases gradually until 1992-1993 as reservoir levels return to normal.

## 3.4 Energy Efficiency

| Objectives | Strategies |
|---|---|
| Develop coherent programs of intervention to promote energy conservation by customers | Starting in 1990, inform customers about energy conservation and begin first measures directly involving them<br>Between 1991 and 1993, implement mass-market energy-conservation programs<br>Reinforce energy-conservation support activities<br>Ensure the technological R & D for energy efficiency |
| Develop and maintain peak-load management programs and flexible markets that enable the balance between supply and demand to be quickly restored when necessary | Increase interruptible-power contracts from 760 megawatts in 1989 to 1,200 megawatts in 1995<br>Expand the base stock of residential dual-energy units from 90,000 in 1989 to 150,000 units in 1992<br>Maintain a base stock of commercial, institutional and industrial dual-energy units<br>Maintain a 1,000-megawatt stock of commercial and industrial electrical boilers |
| Propose rate increases that reflect supply costs to maintain financial soundness and to support marketing and conservation objectives | By 1992, raise rates to cover supply costs, including a satisfactory rate of return on equity<br>Differentiate rate increases by customer category to better reflect costs of supplying each category<br>Prepare a series of rate options that support specific marketing programs<br>Evaluate the possibility of setting seasonal rates |

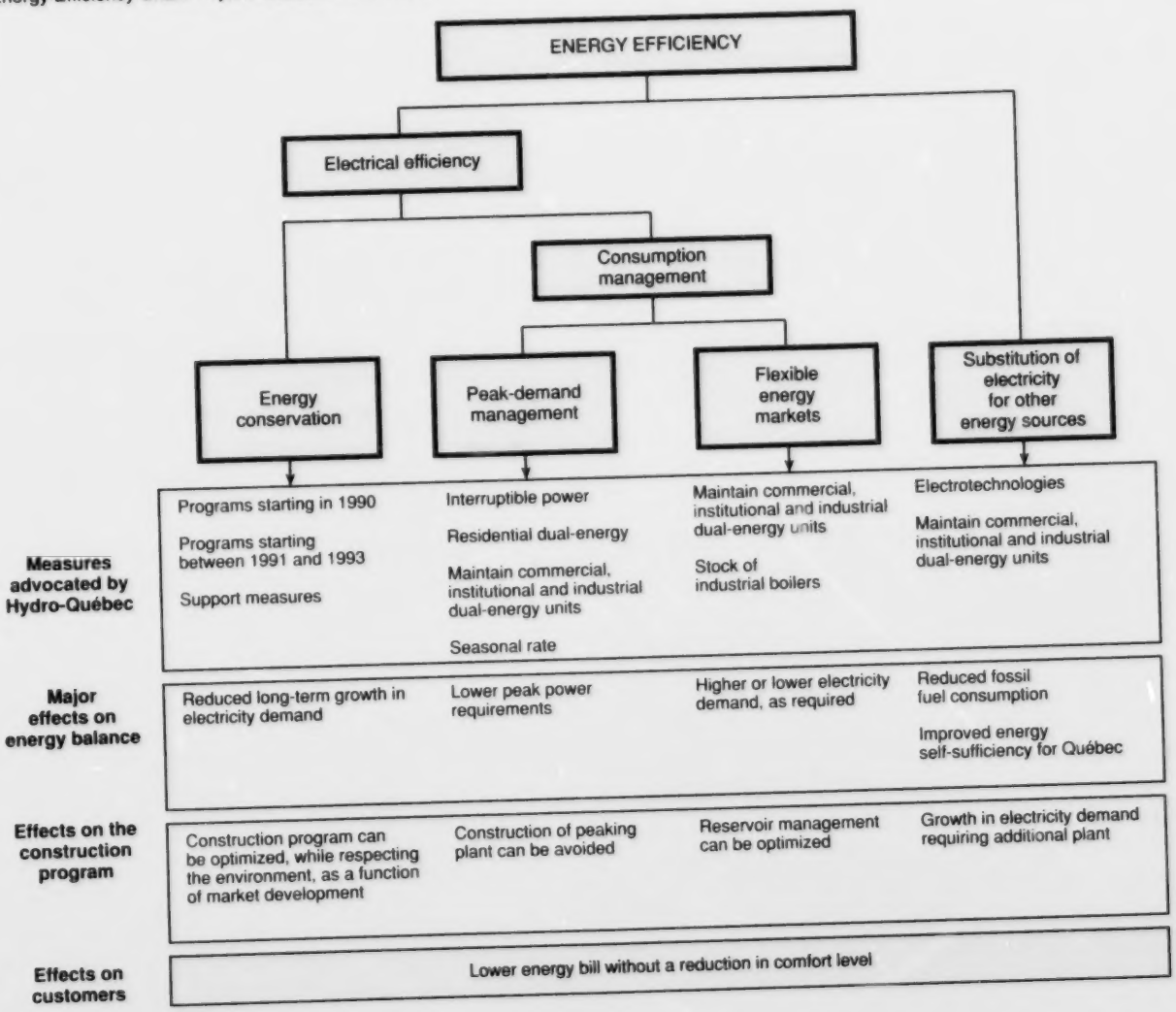
### 3.4.1 Energy Efficiency

In the past, Hydro-Québec was very active in the field of energy efficiency, modifying its actions as the energy context evolved. Thus, during the oil crises of 1973 and 1979, the utility stressed energy conservation, establishing standards for equipment and the insulation of buildings and water heaters. Later, during the period from 1982 to 1986, characterized by major energy surpluses, peak-load management and flexible energy-market approaches were developed.

In the early 1990s, Hydro-Québec intends to give a new emphasis to energy-conservation activities as part of a long-term orientation that initially focuses on electrical efficiency. This orientation follows the Energy Policy of the Québec government adopted in 1988.

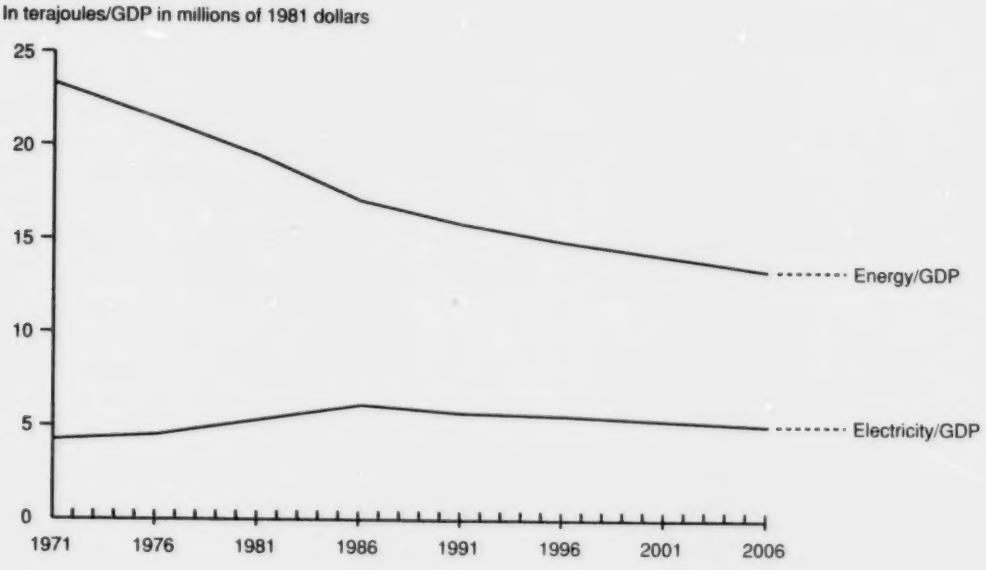
The problem of improving energy efficiency and the utility's long-term orientations and proposed program are discussed at greater length in a separate publication entitled *Hydro-Québec and Energy Efficiency*.

**Figure 3.4**
Energy-Efficiency Chart – Hydro-Québec Interventions


ENERGY EFFICIENCY
Electrical efficiency
Consumption management
Energy conservation
Peak-demand management
Flexible energy markets
Substitution of electricity for other energy sources
Measures advocated by Hydro-Québec
Programs starting in 1990
Programs starting between 1991 and 1993
Support measures
Interruptible power
Residential dual-energy
Maintain commercial, institutional and industrial dual-energy units
Seasonal rate
Maintain commercial, institutional and industrial dual-energy units
Stock of industrial boilers
Electrotechnologies
Maintain commercial, institutional and industrial dual-energy units
Major effects on energy balance
Reduced long-term growth in electricity demand
Lower peak power requirements
Higher or lower electricity demand, as required
Reduced fossil fuel consumption
Improved energy self-sufficiency for Québec
Effects on the construction program
Construction program can be optimized, while respecting the environment, as a function of market development
Construction of peaking plant can be avoided
Reservoir management can be optimized
Growth in electricity demand requiring additional plant
Effects on customers
Lower energy bill without a reduction in comfort level

In Québec, substitution of electricity for fossil fuels has created major gains in energy productivity, given the greater efficiency of hydroelectricity.

**Figure 3.5**
Evolution of Energy Efficiency in Québec




In the 1990s, electrical efficiency will be especially assured by the promotion of:

- energy-conservation measures that, in the long term, aim to encourage rational use of electricity and manage growth in firm electricity needs;

- peak-load management measures and flexible-energy markets that offer the utility effective means of influencing electricity demand in the short term.

### *3.4.2 Energy Conservation*

Despite many achievements in electrical efficiency in Québec, there is still a high additional potential for energy conservation. Current estimates put the amount at 23 terawatthours or 18% of firm-electricity sales in Québec in 1989.

To evaluate, from this theoretical hydroelectric potential, the economically viable potential between now and the end of the decade, Hydro-Québec takes into account a number of factors, chief among which are economic considerations, the uncertainties associated with energy conservation and customer acceptance of the concept of energy conservation.

Factors affecting the projected level of energy savings include how popular the programs are, how much is saved, at what cost and how permanently. The popularity of the programs is affected by the relative price of electricity and other considerations specific to each customer. How much is saved, although difficult to measure, will depend on the actual use that customers make of more efficient equipment. How much these savings cost will depend on technological development and prices charged by equipment distributors. The permanency of the savings is related to changing values and lifestyles, equipment obsolescence and technological development.

The utility encourages the efficient allocation of resources by ensuring that the kilowatthours saved are not more costly than the new kilowatthours obtained from hydroelectric projects and other plant. Thus the sum of the amounts paid by the customer and by the utility must be equal to or less than the avoided costs of electricity generation, transmission and possibly distribution.

So the energy-conservation programs Hydro-Québec will launch will not put any greater long-term upward pressure on rates than would the construction of facilities that might otherwise be needed.

Continuing on the basis of sound economic principles, Hydro-Québec could make a significant financial contribution to the promotion of energy conservation. The utility's rates aim to reflect the costs of supply associated with the various customer categories. These rates are based on the average cost of installations, which is obviously lower than the cost of new installations. So Hydro-Québec is prepared, where necessary, to spend up to the difference between the average cost and the marginal cost of the new installations.

This spending could take the form of information programs, visits or direct contributions to customers.

Customers who receive financial contributions would not, in so doing, place an additional burden, in the form of higher rates, on customers as a whole.

**Programs Beginning in 1990**

There is potential for electrical efficiency in all markets. Uses offering the greatest possibility of energy conservation are:

- residential market: hot water, lighting, heating, household appliances;
- commercial and institutional market: lighting, hot water, HVAC (heating, ventilation and air conditioning);
- industrial market: motors, lighting, improvement in production processes.

However, it should be emphasized that the present perception of Québec customers is not one that lends itself to energy conservation. Electricity prices are relatively low. In other sectors of the economy, although efforts are still being made not to waste energy, and the results have been substantial, there is nevertheless some resistance to additional conservation measures. Greater comfort is often seen as a priority.

Until recently there was a widespread popular perception that electricity was both abundant and cheap. This attitude is due mainly to the energy surpluses caused by the high runoff levels of 1976 to 1983 and by the 1981-1982 recession. In the years of surplus that followed, rate discounts and major sales of surplus electricity played a major role in creating this image of abundance.

*Information Program*

A major information campaign intended primarily for Hydro-Québec customers in the residential and commercial markets will take place throughout 1990. This program will be rapidly followed by the first direct measures to involve residential and commercial customers.

*Residential Program*

Accelerated penetration of a vast range of highly energy-efficient devices and equipment will require formulas calling for participation by customers and commitment by private distributors of this equipment. The main devices now being evaluated are shower heads, fluorescent lights, insulation kits, water-flow reducers, programmable thermostats and insulation jackets for water heaters.

In addition, to increase its expertise and maximize its mass-market programs, Hydro-Québec will launch a pilot program of home energy-conservation visits. The idea will be to evaluate the energy-conservation possibilities of building insulation, water heating and some appliances. Following this evaluation, and with customer consent, the utility will, if need be, ensure the installation of high-energy-performance appliances. The trial will target a sample of low-income customers to offer them the benefits of reduced electricity consumption.

*Commercial Program*

A program involving public lighting is also being prepared. Collaboration with the municipalities involved will increase the program's spinoffs.

*Demonstration Projects*

In the early 1990s, Hydro-Québec will carry out demonstration projects in its own buildings to give concrete examples to its customers, increase expertise in this area and heighten the conservation awareness of all its personnel.

Furthermore, in 1990 the utility will set up several other pilot projects to optimize the proposed programs.

**Programs Beginning between 1991 and 1993**

This phase concentrates on mass-market activities that require a longer period of preparation and organization. It will be characterized by the marketing in all sectors of highly efficient appliances, improved building insulation and better industrial processes. The high-efficiency water heater is one example of equipment that will be proposed to customers in the near future.

Plans also call for establishing a program of home visits to make recommendations based on summary energy analyses and to advise customers on which high-efficiency equipment they should install. Furthermore, Hydro-Québec is also planning visits to commercial premises organized by usage and customer category.

Other possibilities are also under study: improved commercial, institutional and industrial lighting, improved motors and the implementation of electrotechnologies in industry.

**Support Activities**

An essential component of the electrical-efficiency programs is support from regulatory bodies, manufacturers and suppliers, and the general public, specifically in research, development and testing of highly energy-efficient products, such as high-efficiency houses, water heaters, heat pumps with nonelectric backup and integrated dual-energy furnaces, and in efficiency standards and quality labels such as NOVELEC and CASCADE, used in the past. Hydro-Québec will also collaborate with others working in the energy field so that goals in this area can be met.

**Objectives**

The demand-reduction objectives of the energy-conservation programs have been calculated to incorporate profitability criteria, the commercial context and uncertainties related to the programs themselves.

Hydro-Québec's objective is 12.9 terawatthours of energy savings on the 1999 horizon, out of a theoretical potential of 23 terawatthours. This amount consists of natural savings and savings resulting from specific programs. As discussed in section 3.2.2, natural-efficiency savings, which involve minimal interventions on the part of Hydro-Québec and governments, are estimated at 3.9 terawatthours in 1999. This type of energy saving was taken into account in the demand forecasts of previous Development Plans.

Energy savings arising from specific interventions will result from the interaction of rate increases, reduction of cross-subsidization, and the utility's intervention programs. The impact of these measures is estimated at nine terawatthours on the 1999 horizon and will entail expenditure of $1.8 billion from 1990 to 1999. This amount includes $160 million for support measures, of which a portion will contribute to natural-efficiency savings.

One of the utility's major concerns is obtaining an accurate evaluation of the impact of its energy-conservation measures. To date, the efforts made by other utilities have been inconclusive because of the numerous factors that affect energy consumption. Nevertheless, pilot projects and measurement and follow-up techniques will be used to assess the impact of the measures implemented.

The anticipated reduction in demand from each program will be systematically revised. Clearly, the greater the number of customers who adhere to the programs, the greater the success would be. The growth rate of electricity demand will also affect potential savings.

The energy-conservation programs will require major commitments by the utility in terms of human and financial resources.

**Table 3.10**
Energy Conservation – 1990-1999

| Method | Impact of programs and rates structure (TWh) 1996 | 1999 | Beginning of programs | Length (years) | Cost to Hydro-Québec (in millions of dollars) |
|---|---|---|---|---|---|
| **Residential**<br>• Devices – promotions<br>• Devices – brochures<br>• Energy analysis<br>• Electric water heaters | 3.3 | 4.7 | 1990-1992 | 2 to 10 | 540 |
| **Commercial and institutional**<br>• Analyses of Hydro-Québec buildings<br>• Analyses of institutional buildings<br>• Public lighting<br>• Applications to small and medium-sized business | 2.2 | 2.8 | 1990-1992 | 3 to 8 | 800 |
| **Industrial**<br>• Energy analyses<br>• Energy initiatives<br>• Promotion of high-efficiency motors | 1.1 | 1.5 | 1990-1992 | 7 to 10 | 300 |
| **Natural conservation** | 2.9 | 3.9 | – | – | * |
| **Support measures** | – | – | – | – | 160* |
| **Total energy conservation** | 9.5 | 12.9 | – | – | 1,800 |

* A portion of the support measures will contribute to natural conservation.

### *3.4.3 Methods of Managing Peak Demand and Flexible Energy Markets*

Given the considerable variations in runoff and demand, Hydro-Québec must develop and maintain a wide range of methods for influencing Québec's power and energy markets. Their implementation will require ongoing collaboration with other parties in the energy sector.

#### Interruptible-Power Program

The interruptible-power program is an efficient peak-shaving tool. Customers that join the program agree to reduce their electricity consumption at Hydro-Québec's request, and this reduces the need for high-peaking plant, such as gas turbines. A conclusion drawn from a review of program conditions in 1989 was that interruptions should be longer, when necessary, i.e., from 7:00 a.m. to 7:00 p.m.

In 1989, the utility introduced a new option which was better suited to its needs and which implied 16-hour interruptions. The pulp and paper sector would be particularly interested in this option. However, given many customers' limited ability to reduce their electricity needs over such a long period, the long-term sales objective has been reduced to 1,200 megawatts from 2,000 megawatts last year.

At present, 760 megawatts of interruptible power is under contract. But program revisions that take into account customers' operating methods and the system's peak-load management constraints now offer customers the option of contracting for three megawatts, whereas they were previously limited to five megawatts or more, and the premiums paid reflect the option selected.

#### Residential Dual-Energy Heating

Dual-energy heating uses electricity about 80% of the time, with another source of energy, such as heating oil, taking over during peak periods. The utility considers this an attractive alternative to all-electric heating. New homes built in Québec are over 90% electrically heated, and this increases peak demand. Dual energy, however, is an advantageous choice, both for the customer, who pays a lower rate, and for Hydro-Québec, which has less need for peak-load thermal generating facilities – a much less efficient use of energy for residential heating.

Residential dual-energy units were first developed in 1983 as an alternative to conversion from heating oil to all-electric heating. The current program dates back to 1987, when customers who opted for dual energy were given special rates. In 1989, the utility extended the program to dual-energy systems using heat pumps and dual-energy systems serving more than one dwelling. The dual-energy (DT) rate combined with a repairs and maintenance program enables customers to significantly reduce their electricity bills.

Hydro-Québec will maintain its current dual-energy stock of 90,000 units, and expects to increase it to 150,000 units by 1992. This increase will take place on the existing all-electric market and on the new market. Advanced technologies such as heat pumps with nonelectric backup and integrated dual-energy heating systems will help the utility achieve this objective.

In addition, Hydro-Québec is studying the possibilities of using residential dual energy as an energy reserve in the interests of customers and the utility.

**Commercial, Institutional and Industrial Dual Energy**

The commercial, institutional and industrial dual-energy program began in 1984 and ended in 1988. Its main purpose, in a period of electricity surpluses, was to accelerate substitution of electricity for other sources of energy, without requiring additional peak-load facilities.

This heating method can switch temporarily to a backup source during periods of low runoff. Such was the case in 1990, when Hydro-Québec temporarily bought back contracts, to the mutual benefit of the utility and its customers. This is a less costly option than other ways of reconstituting energy reserves, such as peak-period imports from neighboring systems.

**Industrial Boilers**

An emergency-repairs and maintenance rate is offered to an electric-boiler stock totalling 1,000 megawatts in the industrial sector. In the event of high runoff, surplus electricity could be sold to this market.

### *3.4.4 Technological Development*

Many research projects on electricity uses are now under way in Hydro-Québec's laboratories or in collaboration with partners from universities and the private sector. The emphasis is on industrial electrotechnologies and dual-energy heating systems. The results of these projects will enable the utility to determine options that could become the basis for marketing programs.

In the next few years, research will focus on the following applications: heat pumps with nonelectric backup, improved electric water heaters, integrated dual-energy systems (electricity-oil), storage heating, industrial drying processes, high-temperature heating processes, electrochemistry and high-efficiency heat pumps.

Adoption of electrotechnologies not only increases the ability of Québec industries to compete, but also enhances their energy efficiency. Hydro-Québec will also promote the replacement of existing electrical processes by more efficient ones, with efforts focusing on the most efficient electrotechnologies.

### *3.4.5 Price Signalling from Rates Policy*

**Principles of the Rates Policy**

Hydro-Québec's rates policy is based on the following principles:

- to maintain standard rates throughout Québec and standard treatment for customers with similar consumption characteristics;
- to ensure that the rates categories, to the extent possible, gradually but accurately reflect the varying cost of supply;
- to facilitate understanding and application of the rates policy;
- to take customers' methods of operation into consideration.

There must be incentives to adopt energy-savings measures, and price signalling through the rates that customers pay is of the utmost importance because energy conservation is more difficult to justify if prices do not properly reflect supply costs. If Hydro-Québec is to ensure that electricity is used efficiently, it is important that customers be fully aware of the costs incurred to meet their needs.

The rates structure must reflect costs of supply and provide a return on equity comparable to those of other utilities. In this way, a number of objectives can be met simultaneously. First, a rates structure based on costs of supply enables Hydro-Québec to re-establish and maintain a financial margin of manoeuvre that hedges it against the inevitable economic, energy and climatic uncertainties, without major rate shock for its customers. Moreover, by ensuring a sound financial position, it helps finance the capital investments necessary to meet demand growth and service-quality objectives. Lastly, by giving customers a better price signal, it promotes more efficient use of electricity.

Supply costs vary a great deal, depending on the season and rates category. A customer supplied with high voltage from the transmission system requires much less of an investment in equipment by Hydro-Québec than a customer supplied with low voltage from the distribution system. In addition, Hydro-Québec must build some facilities specifically to meet the winter peak demand. For this reason, electricity supplied during the winter costs more to generate than electricity supplied during the summer.

So costs of supply are higher for a residential customer with low-voltage supply and using all-electric heating in winter than for a large-power customer whose demand is stable throughout the year. Moreover, in the years to come, major investment in the distribution system and in peak-load facilities will cause the costs of supplying residential customers to rise even faster.

The Québec government has approved Hydro-Québec's objective of reducing cross-subsidization. Recommendations on future rate increases will reflect this objective, although care will be taken to avoid rate shocks and to spread the correction of the current cross-subsidization over several years.

**Time-of-Use Rates**

Time-of-use rates are one way of promoting energy savings. Hydro-Québec already offers such an option to residential customers with dual-energy heating systems. Similarly, certain components of existing rates, such as progressive residential rates and the general-sector "optimization" (overrun) charge, reflect the seasonal nature of the utility's costs and promote better use of generating facilities. Hydro-Québec will examine the advisability of offering a seasonal rate to customers.

An hourly rates structure cannot be gainfully introduced in Québec because the daily winter peaks in Hydro-Québec's system occur over a long period of time, due to the use of electric heating.

## 3.5 External Markets

| Objectives | Strategies |
|---|---|
| Develop and maintain agreements that enhance the utility's flexibility by enabling it to balance supply and demand | Purchase available energy or sell surplus energy according to foreseeable reservoir levels<br><br>Meet a portion of peak-power needs in years to come with purchases from neighboring systems, when it is advantageous to do so |
| Continue optimum use of interconnections and increase their capacity as required | Negotiate the necessary agreements with neighboring systems regarding the operation of interconnections<br><br>Plan interconnections so as to maximize exchanges with neighboring systems |
| Pursue the long-term sales objective of at least 3,500 megawatts of firm electricity | Pursue endeavors to obtain all approvals required to implement agreements already signed<br><br>Pursue ongoing negotiations for the sale of blocks of firm power and energy, with deliveries after the year 2000<br><br>Continue to evaluate the potential of long-term markets to identify the most attractive opportunities |

In the short term, imports and exports make it possible to reduce the impact that variations in runoff and demand have on reservoir levels. In recent years, Hydro-Québec has used its interconnections with neighboring systems to sell its surplus energy to neighboring systems. Revenue of more than $5 billion generated in this way from 1980 to 1989 has enabled the utility to keep Québec rates at least 10% lower than they otherwise would have been, and has also helped finance the expansion and upgrading of the power grid. Moreover, the inflow of US dollars has facilitated management of the utility's foreign-exchange risk.

In the long term, firm power and energy exports will be very profitable and will generate substantial economic spinoffs in Québec. Long-term exports involve bringing forward the construction of facilities not immediately required to meet Québec needs. The prices obtained under export contracts are about double Québec's large-power industrial rate, which is a comparable product. Export revenue pays for all expenses related to earlier construction and offers a good return on equity. When the contracts expire, Québec will have facilities that would have been far costlier to build at a later date.

In terms of revenue, income and profitability, and of impact on the Québec economy, electricity exports rank among the projects most advantageous to Québec.

In the overall scheme of environmental problems, moreover, exports of hydroelectric energy to neighboring systems contribute in the long term to reducing acid rain and the greenhouse effect, for which thermal generating stations are partially responsible. Interconnections are also used to import energy, thereby reducing the need to build new plant, especially peaking plant.

**Figure 3.6**
Purchases from and Sales to Neighboring Systems

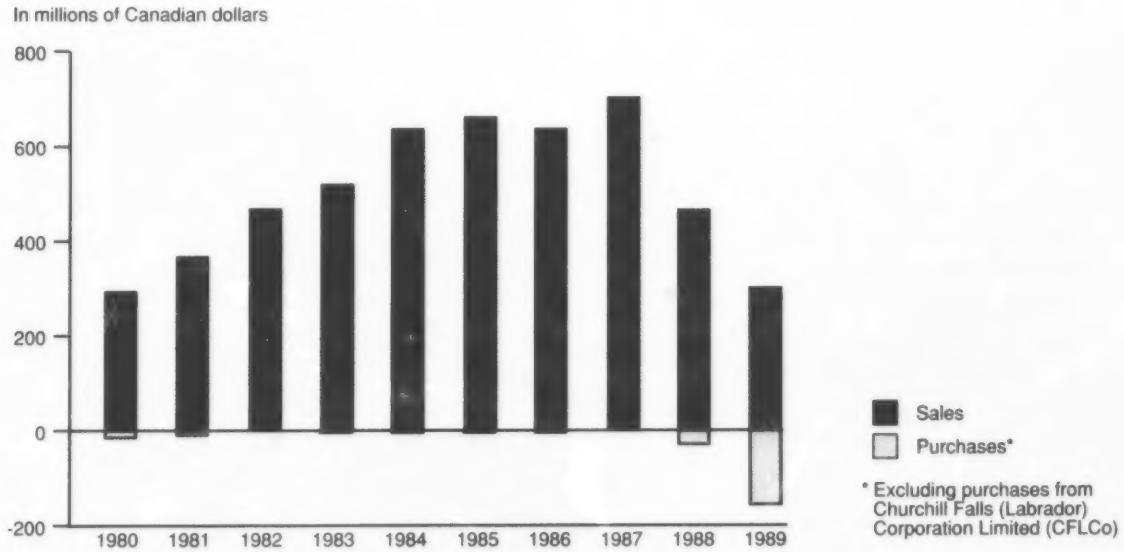


**Table 3.11**
Summary of Contracts and Agreements with Neighboring Systems

| | Start of deliveries | Expiry date | Power (MW) | Maximum annual energy (TWh) | Maximum total energy (TWh) |
|---|---|---|---|---|---|
| **Firm-power and energy contracts** | | | | | |
| CANADA | | | | | |
| New Brunswick Electric Power Commission | 1987 | 1990 | 50 | 0.4 | 1.2 |
| New Brunswick Electric Power Commission | 1988 | 1994 | 50-350 | 3.5 | 20.0 |
| Cedars Rapids Transmission Company | 1915 | 1999 | 56 | 0.5 | 42.0 |
| UNITED STATES | | | | | |
| Citizens Utilities Company | 1986 | 1990 | 20-56 | 0.3 | 1.1 |
| Citizens Utilities Company | 1986 | 1990 | 32-40 | 0.1 | 0.3 |
| New York Power Authority (NYPA) | 1978 | 1998 | 800 | 3.0*** | |
| New York Power Authority (NYPA) | 1995 | 2016 | 1000* | 6.6 | 131.0 |
| New York Power Authority (NYPA) | 1999 | 2018 | 800 | 3.0 | 60.0 |
| Vermont Department of Public Service | 1985 | 1995 | 150 | 1.3 | 13.0 |
| Vermont Joint Owners | 1990 | 2020 | 450** | 3.0 | 62.0 |
| Vermont Joint Owners | 1987 | 1990 | 50 | 0.4 | 1.2 |
| Vermont Utilities | 1989 | 1991 | 54 | 0.5 | 0.8 |
| **Firm-energy sales contract** | | | | | |
| UNITED STATES | | | | | |
| New England Utilities | 1990 | 2000 | – | 7.0 | 70.0 |
| **Surplus-energy sales contracts #** | | | | | |
| UNITED STATES | | | | | |
| NEPOOL Participants | 1986 | 1997 | – | 4.0 | 33.0 |
| New York Power Authority (NYPA) | 1984 | 1997 | – | 11.0 | 111.0 |
| **Power-purchase contracts** | | | | | |
| CANADA | | | | | |
| Gulf Power | 1970 | – | 3 | – | – |
| UNITED STATES | | | | | |
| New York Power Authority (NYPA) ## | 1989 | 2011 | 400 | – | – |
| **Interconnection and operating agreements** | **Effective date** | **Expiry date** | | | |
| CANADA | | | | | |
| Alcan (SECAL) | 1982 | – | | | |
| Maclaren (CEMQ) | 1984 | – | | | |
| Compagnie hydroélectrique Manicouagan | 1986 | – | | | |
| Gulf Power | 1970 | – | | | |
| New Brunswick Electric Power Commission | 1979 | – | | | |
| Ontario Hydro | 1979 | – | | | |
| Cornwall Electric | 1989 | – | | | |
| UNITED STATES | | | | | |
| Citizens Utilities Company | 1987 | – | | | |
| New England Power Pool (NEPOOL) | 1986 | – | | | |
| New England Power Pool (NEPOOL) ### | 1986 | 2004 | | | |
| New York Power Authority (NYPA) | 1978 | 1998 | | | |
| Niagara Mohawk Power Corporation | 1982 | – | | | |
| Vermont Department of Public Service | 1985 | – | | | |
| Vermont Joint Owners | 1987 | – | | | |

* 500 megawatts in 1995-1996 and in 2015-2016.
** VJO may exercise options to reduce maximum power by 110 megawatts.
*** The agreement on the associated energy is subject to regular negotiations; the current agreement ends in 1990. Deliveries from April to October.
# The amounts of energy offered depend on the surpluses available.
## Peak power deliveries from November to March.
### Energy-banking agreement.

### *3.5.1 The Short Term*

**Orientations**

Since 1988, low runoff and sustained demand have halted sales of surplus electricity and necessitated purchases of electricity from neighboring systems, which have been possible thanks to flexible agreements negotiated in the past that give Hydro-Québec the ability to adapt to short-term changes.

**Actions**

*Reduction in Export Sales*

In 1988 and 1989, the utility stopped delivering electricity under surplus-energy contracts. Deliveries to members of the New England Power Pool (NEPOOL Participants) and to the New York Power Authority (NYPA) under two interruptible-energy contracts were halted. Other sales of surplus energy under interconnection agreements were also suspended. These sales may resume when Hydro-Québec again has surpluses.

*Purchases from Neighboring Systems*

Hydro-Québec uses the diversity between its system and neighboring systems, both in terms of generating facilities and demand characteristics, to meet a portion of its power needs.

In winter, for example, certain systems to the south have surplus power because of their warmer weather. In summer, however, these systems must cope with peak demand because of increased use of air conditioning. Hydro-Québec can therefore sell them power it does not need at this time.

Other systems also have temporary power surpluses that they can make available as required. Hydro-Québec will continue to purchase power from neighboring systems, when it is advantageous to do so to meet a portion of its needs. And these exchanges will reduce both systems' need for peak-load facilities.

When runoff is high, rather than spilling the surplus from its reservoirs, Hydro-Québec can sell this to neighboring systems as surplus energy, to the benefit of all its customers. Although the prices in this instance are lower than those for firm sales, the arrangement is still an attractive source of revenue. Similarly, when runoff is low, the utility can purchase energy from neighboring systems. This enables Hydro-Québec to store water in its reservoirs to maintain its energy reserve. Energy purchases are usually made during off-peak hours, when the amount of energy available is greatest and prices are lowest.

From October 1988 to December 1989, Hydro-Québec purchased 4.7 terawatthours from neighboring systems and it plans to purchase 3.5 terawatthours for 1990, in an average-runoff scenario, to re-establish its energy reserve.

### *3.5.2 The Long Term*

**Orientations**

In recent years, Hydro-Québec has pursued the objective of long-term export sales of 3,500 megawatts of firm electricity, but this could be exceeded, depending on long-term changes in demand in Québec and on neighboring systems. These sales enable the purchasers to avoid construction of new thermal generating facilities and, when the contracts expire, Hydro-Québec will have less costly additional plant, formerly required for export, at its disposal to meet internal demand. So these contracts are profitable for Hydro-Québec and ultimately for all Québecers.

Apart from contracts already signed, i.e. 2,250 megawatts, including 800 megawatts of summer deliveries, Hydro-Québec is now negotiating others for 1,500 to 2,000 megawatts for deliveries beginning after 2000. The realization of these new agreements will depend on the value that neighboring systems place on a reliable and relatively non-polluting source of supply and the competitiveness of the price offered.

## Contracts

Table 3.12 lists contracts signed with neighboring systems as part of the long-term sales objective of 3,500 megawatts; others will be added to attain this objective. All contracts already signed are conditional on the issuance of permits by the regulatory bodies in Canada and the United States, with both parties, Hydro-Québec and its partners, providing mutual assistance in order to obtain them.

For example, Hydro-Québec is actively involved in public hearings before the Public Service Board of the State of Vermont to obtain approval of a contract with Vermont Joint Owners (VJO) signed on December 4, 1987. Deliveries would begin in 1990 with 107 megawatts and would gradually climb to a maximum of 450 megawatts in 2000 if VJO exercised all its options. In Canada, this contract requires export licences from the National Energy Board, and Hydro-Québec must demonstrate that the project meets the Board's electricity-export criteria.

In 1989, Hydro-Québec concluded with the New York Power Authority (NYPA) a long-term firm-electricity sales agreement totalling 1,000 megawatts and about 6.6 terawatthours per year for 20 years, beginning in 1995-1996. On January 23, 1990, the utility and NYPA signed another long-term sales agreement for 800 megawatts and three terawatthours of firm electricity to be available in the summer. This 20-year contract will take effect in 1999. Both require approval by US and Canadian regulatory authorities and will be of mutual benefit to Hydro-Québec and the State of New York.

**Table 3.12**
Contracts as Part of the Export Objective of 3,500 Megawatts

| Customers | Start of deliveries | End of deliveries | Maximum power (MW) | Maximum annual energy (TWh) | Maximum total energy (TWh) |
|---|---|---|---|---|---|
| Vermont Joint Owners | 1990 | 2020 | 450* | 3.0 | 62 |
| New York Power Authority (NYPA) | 1995 | 2016 | 1000 | 6.6 | 131 |
| New York Power Authority (NYPA)** | 1999 | 2018 | 800 | 3.0 | 60 |

* Vermont Joint Owners may exercise options to reduce maximum power by 110 megawatts
** From April to October

A contract for the purchase of 400 megawatts of peak winter power was also signed with NYPA in 1989. Deliveries under this 22-year contract began last November and will continue from November to March each year until 2011.

The sale of 800 megawatts and the purchase of 400 megawatts enables both systems to avoid constructing peak facilities, because Hydro-Québec's peak occurs in winter, whereas NYPA's occurs in summer.

Also in 1989, following the Public Utilities Commission of the State of Maine's refusal to approve a contract between Central Maine Power Company (CMP) and Hydro-Québec, the utility exercised its right to terminate this contract.

**Negotiations in Progress**

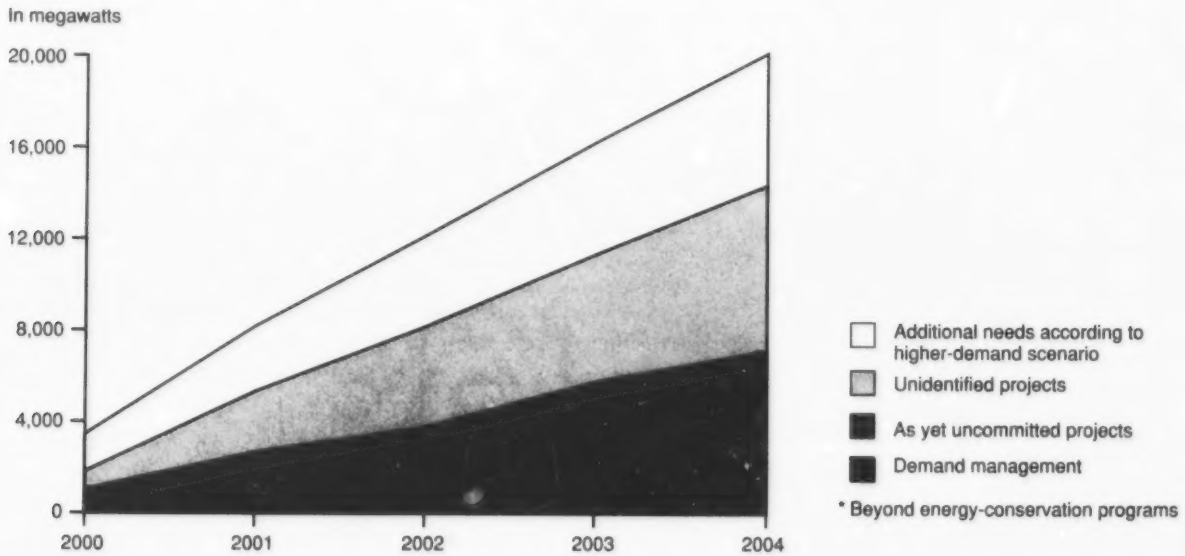
Hydro-Québec is continuing negotiations with neighboring systems regarding the long-term supply of firm power and energy.

The target market, located principally in the northeastern United States, is a replacement market for new base-load generating stations using fuel oil, coal or natural gas. These are required to meet the greater electricity demand in this region and to replace generating stations that will have exceeded their service life.

**Long-Term Market Potential**

Data from the neighboring systems' development plans indicate that, from 2000 to 2004, new needs to be met will total slightly more than 14,000 megawatts, of which about 2,400 megawatts will be provided by demand-management programs, 4,700 by projects not yet committed, and 7,000 megawatts by projects not yet identified. Assuming that electricity demand on neighboring systems grows by half a percentage point more than their forecasts, their additional needs from 2000 to 2004 will be almost 6,000 megawatts.

**Figure 3.7**
Satisfaction of Neighboring Systems' Projected Power Needs*



In addition to the demand-management and energy-conservation programs planned, neighboring systems have several options: extending the service life of existing generating stations, building new thermal and combined-cycle stations, and purchasing electricity from independent producers or from neighboring systems. Despite natural gas's increasing attractiveness to the northeastern United States, its limited availability will prevent it from meeting more than a small portion of these needs.

Excluding peak-demand management and energy-conservation programs and taking into account only projects not identified by neighboring systems and a portion of the as-yet uncommitted projects, the market accessible to Hydro-Québec is estimated at 9,000 megawatts, over and above contracts already signed. In the high-growth scenario, the potential accessible market would rise from 9,000 to 14,000 megawatts.

Hydro-Québec will continue evaluating the needs of neighboring systems to identify the most advantageous market opportunities.

**Table 3.13**
Forecast Exports Compared with Total Hydro-Québec Sales

| | Export sales | | | | % of total sales | | | |
|---|---|---|---|---|---|---|---|---|
| | 1991 | 1996 | 2001 | 2006* | 1991 | 1996 | 2001 | 2006 |
| Energy (in terawatthours) | 12.6 | 15.2 | 19.3 | 24.5 | 10.0 | 8.7 | 10.0 | 11.8 |
| Power (in megawatts) | 438 | 948 | 2,550 | 3,550 | 1.5 | 2.9 | 7.3 | 9.5 |

* The objective of 3,500 megawatts will be reached in about 2003.

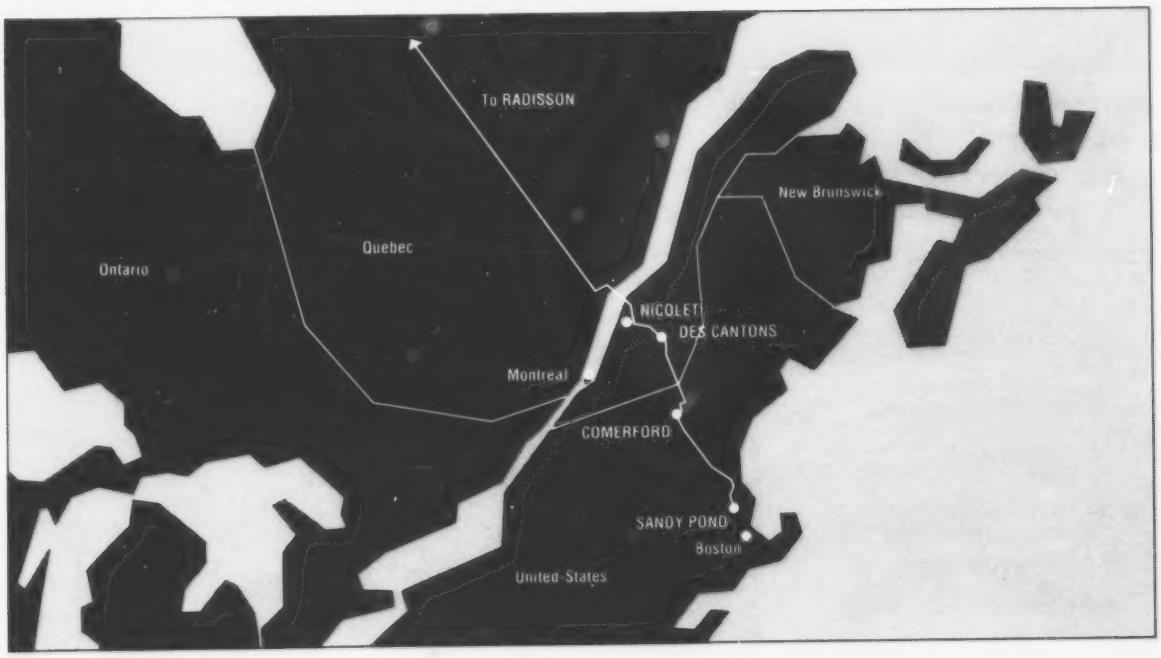
*3.5.4 Interconnections*

**Current Situation**

Hydro-Québec's interconnection capacity with its principal neighbors depends on a number of factors, such as the size of loads, the output of the generating stations connected to the line, and the technical limitations of the systems. Accordingly, the import and export capacities indicated on Map 3.2 may differ.

In 1990, the rated capacity of the direct-current interconnection with NEPOOL will increase from 690 to 2,000 megawatts. To make this possible, the Radisson-Nicolet-des Cantons line and Radisson converter station will be commissioned in Québec and, in the United States, the line between Comerford station in New Hampshire and the new Sandy Pond converter station in Massachusetts will be commissioned. Commercial commissioning of this interconnection will take place in 1990, marking the beginning of deliveries under the firm-energy contract with New England Utilities. This contract, which runs until 2000, will enable Hydro-Québec to export 7.0 terawatthours a year to New England Utilities.

**Map 3.1**
Radisson-Nicolet-des Cantons-Comerford-Sandy Pond Direct-Current Line

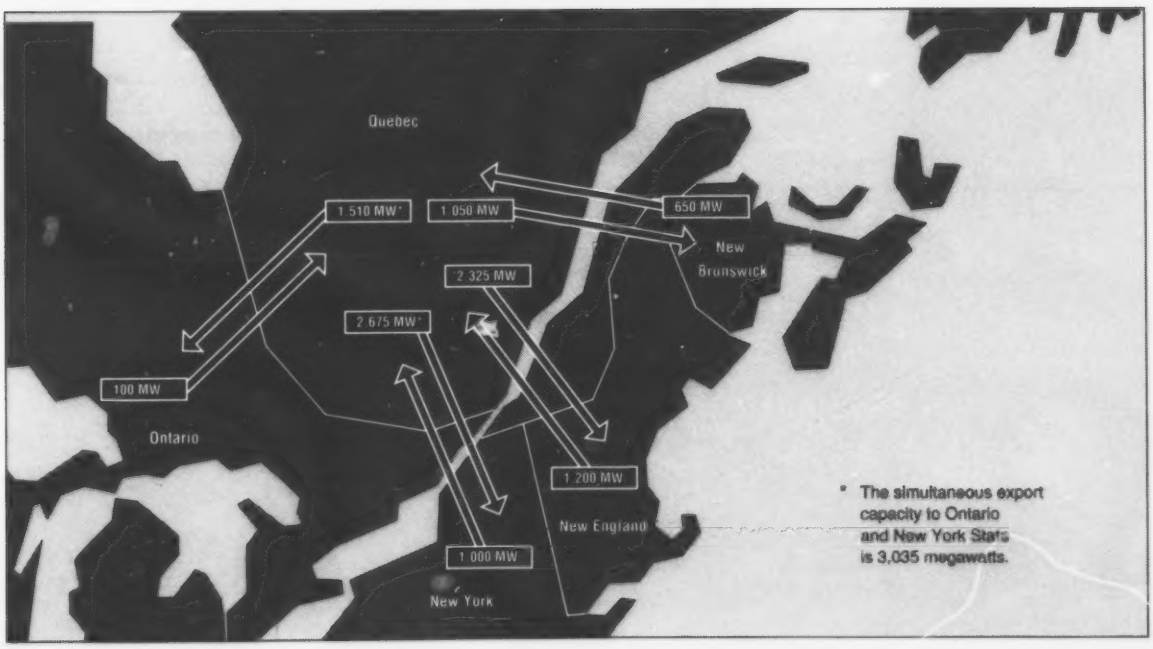


## Orientations

In general, interconnections improve power-system reliability and enable utilities to derive maximum benefit from system complementarity. They also permit the pooling of availabilities to meet power and energy demand.

Hydro-Québec is examining the possibility of building new interconnections to increase its exchange capacity with neighboring systems. Additional interconnections would enable the utility to purchase electricity from neighboring systems as required or sell any surpluses.

**Map 3.2**
Interconnections with Neighboring Systems in the Fall of 1992



## 3.6 *Construction Program*

| **Objectives** | **Strategies** |
|---|---|
| Ensure, in the medium term, commissioning of generating and transmission facilities required to meet the needs of Québec markets and contractual export commitments | 1. Commission the following facilities<br>– additional capacity at La Grande 2 generating station in 1991-1992 and related transmission facilities<br>• Radisson converter station and the 450-kV DC line in 1990<br>• Nicolet converter station in 1992<br>• the underwater crossing of the DC line in 1992<br>– the generating stations in phase II of the La Grande complex<br>• Brisay in 1993<br>• Laforge 1 in 1994<br>• La Grande 1 in 1994-1995<br>and related transmission facilities<br>• the 12th line of the transmission system in 1993 (north section) and 1994 (south section)<br>• the 315-kV lines required to integrate Laforge 1, Laforge 2 and Brisay generating stations into the system<br>• the 735-kV line between Lemoyne and Tilly substations in 1994<br>– Laforge 2 generating station in 1995<br>– Eastmain 1 generating station in 1996<br>– the Grande Baleine complex as of 1998 and related transmission facilities<br>• the 315-kV collector network and the 14th line in 1998<br>– changes to Manic 5 turbine runners beginning in 1991<br>– gas turbines at La Citiere and Bécancour in 1992-1993<br>2. Supply power to unconnected systems<br>– Commission the following facilities<br>• Robertson generating station in 1995<br>• Blanc Sablon diesel generating station in 1992<br>– Complete activities required for the upgrading of Magdalen Islands diesel generating station between 1990 and 1992<br>3. Continue studies on the Lévis-des Cantons line to strengthen supply to the south shore of the St. Lawrence beginning in 1995 |

| Objectives | Strategies |
|---|---|
| Plan Hydro-Québec's generating and transmission facilities to create the margin of manoeuvre needed to adjust rapidly to changes in long-term markets. | 1. Optimize all activities necessary for the completion by the year 2000 of the Nottaway-Broadback-Rupert project, the keystone of the utility's long-term construction program<br>2. Prepare for decisions regarding generating and transmission facilities. To this end, obtain required government authorizations, continue studies and initiate activities needed to retain the earliest commissioning options for the following projects<br>– Sainte-Marguerite generating station by 1999; in 1990, begin process of obtaining sectorial authorization for access infrastructure<br>• reach agreement with the various interested parties on timetable for recovery of merchantable timber that allows commissioning to proceed as scheduled<br>– Ashuapmushuan River developments by 1999<br>– developments on the Haut-Saint-Maurice by 1998<br>– additional capacity at Manic 3 by 1995 and Manic 2 by 1996 and related transmission facilities<br>• an AC line to the North Shore to carry additional output from the Manicouagan complex (13th transmission line)<br>3. Begin a draft-design study in 1990 for a combined-cycle gas-turbine generating station<br>4. Explore with Newfoundland the possibility of building Gull Island and Muskrat Falls generating stations to develop the Lower Churchill River<br>5. Purchase electricity from independent producers whose output meets Hydro-Québec's operating standards |

*3.6.1 Hydroelectric Potential and Other Possibilities*

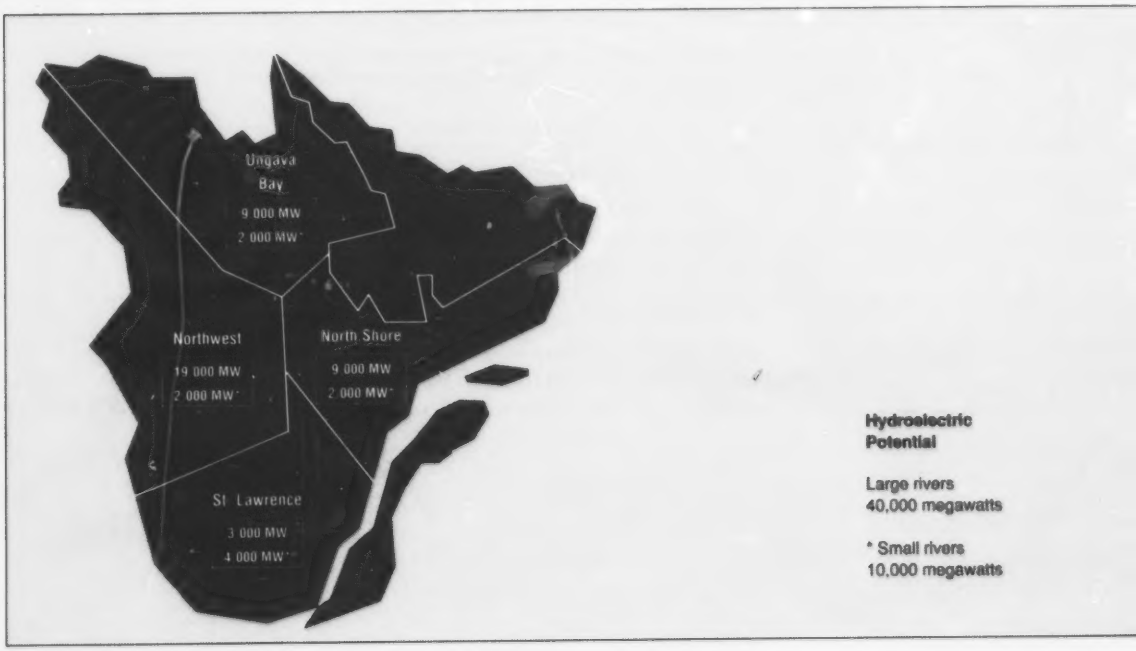
**Large Rivers**

Large undeveloped rivers represent potential annual energy generation of 200 terawatthours. At a load factor of 60%, this means about 40,000 megawatts of power. Of this potential, about 18,800 megawatts, or 100 terawatthours, is economically viable, and impact-assessment studies will be carried out on it, to optimize the necessary mitigative measures.

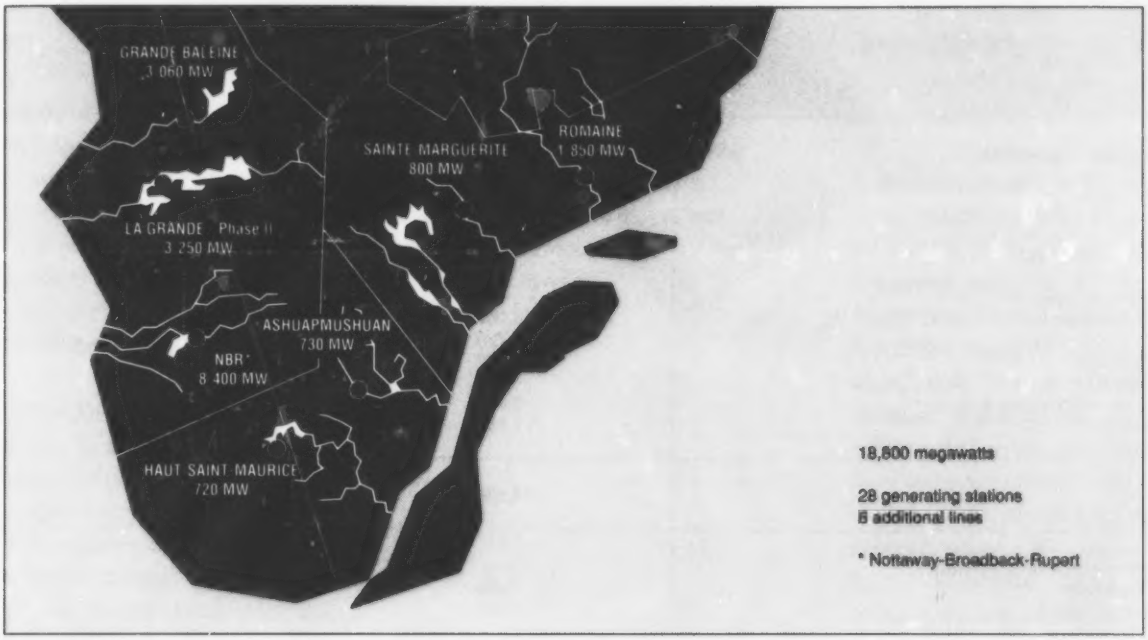
This economically viable potential is about 800 megawatts higher than forecast in last year's Development Plan, mainly due to the addition of the Haut-Saint-Maurice project.

Other than the energy-conservation programs outlined in section 3.4.2, these projects are more economical than any other generating option (nuclear, oil-fired or coal-fired), including the costs of transmitting the electricity to load centres. The Northwest is the region with the best development prospects, as it contains 75% of the potential.

**Map 3.3**
Québec's Hydroelectric Potential



**Map 3.4**
Québec's Economically Viable Hydroelectric Potential




**Small Rivers**

More than 400 small rivers, scattered throughout Québec, offer combined potential of 10,000 megawatts. This is divided among numerous sites with a potential of less than 100 megawatts, and in most cases as little as one or two megawatts. However, a large portion of this potential could not be developed economically under present conditions.

**Table 3.14**
Economically Viable Hydroelectric Potential

| Hydroelectric generating stations or complexes | Available power at peak (MW) | Average annual generation (TWh) |
|---|---|---|
| **Projects in progress** | | |
| La Grande 1 | 1,310 | 7.3 |
| Laforge 1 | 820 | 4.5 |
| Brisay | 380 | 2.3 |
| **Future projects** | | |
| Laforge 2 | 270 | 1.7 |
| Sainte-Marguerite | 800 | 4.1 |
| Grande Baleine | 3,060 | 16.2 |
| Ashuapmushuan | 730 | 3.5 |
| Eastmain 1 | 470 | 2.7 |
| Haut-Saint-Maurice | 720 | 3.5 |
| Nottaway-Broadback-Rupert | 8,400 | 45.3 |
| Romaine | 1,850 | 8.4 |
| **Total** | 18,800* | 100 |
| **Other projects under study** | | |
| Péribonka | 400 | 2.2 |
| Petit Mécatina | 1,450 | 7.6 |

* Values have been rounded up to the nearest 100 megawatts.

### Peaking Facilities

Additional peaking facilities will be required to meet peak demand in Québec. For medium-peak periods, it is currently more economical to build additional capacity at existing hydroelectric generating stations, such as at Manic 5 PA, commissioned in the winter of 1989-1990, and at La Grande 2A, which will be commissioned in 1991-1992. Similar projects are planned for the generating stations on the Manicouagan River and are under study for those on the Betsiamites, Aux Outardes and Saint-Maurice rivers. For very high peak loads that exceed peak-demand-management programs, Hydro-Québec plans to install additional gas turbines at La Citière, and is evaluating the purchase of peaking power from neighboring systems.

### Transmission Facilities

To carry the energy generated in northern Québec to the load centres, alternating-current high-voltage lines (735 or 315 kilovolts) remain the proven technical solution best adapted to the configuration of Québec's power grid.

To integrate the 18,800 megawatts of economically viable potential, eight new high-voltage transmission lines would be needed, six for output from the northwest and two for output from the North Shore.

### Purchases of Electricity from Independent Producers

Hydro-Québec has adopted a policy for purchasing electricity from independent Québec producers. According to this policy, the utility purchases electricity from producers whose installations meet the integration and operating standards of its power system.

The output, under this policy, may come from hydroelectric stations with installed capacity of 25 megawatts or less, from incinerators for municipal or forest waste, or from combined steam and electricity generating facilities. In the case of a small generating station whose output is 25 megawatts or less, the independent producer must first obtain the required hydraulic rights from the Québec government.

Hydro-Québec pays a rate that reflects its avoided costs over the lifetime of the contract with the independent producer. In addition to diversifying the utility's sources of output, independent generation helps to develop Québec expertise in this area and create regional economic spinoffs.

Independently produced output that the utility will connect to its power system between now and 1995 is estimated at 390 megawatts, of which 300 megawatts will be from combined generation and 90 megawatts will be from incinerators and small hydroelectric generating stations.

**Purchases of Hydroelectric Generation**

Hydro-Québec will pursue discussions with Newfoundland on construction of Gull Island generating station (1,700 megawatts) and Muskrat Falls generating station (800 megawatts) as part of the development of the Lower Churchill River.

*3.6.2 Construction-Program Design Criteria*

**Reliability Criteria**

*Energy Reserve*

As discussed in section 3.3, the power system is subject to more or less lengthy periods of high and low runoff. Moreover, long-term energy demand can fluctuate significantly because of changes in the economy. To cope with this situation, Hydro-Québec uses enormous reservoirs with a capacity of 140 terawatthours, including Churchill Falls. Almost 40% of this energy is required for seasonal needs, which means the rest must be left to manage interannual variations in runoff or demand.

In previous Development Plans, on the 1995 horizon an energy reserve of about 110 terawatthours was required to cope with fluctuating runoff over a four- year period. It consisted of an interannual hydraulic reserve and the option of using exceptional methods, such as Tracy thermal generating station and purchases from neighboring systems.

As announced in last year's Development Plan, in 1989 the utility reviewed the energy-reliability criteria used to establish the construction program. In light of past runoff statistics and demand uncertainties, the need for an energy reserve has been re-evaluated on the 1995 horizon at 120 terawatthours for a four-year period or 150 terawatthours for a six-year period.

To ensure its energy reserve, Hydro-Québec has based its long-term planning of facilities on a slight hydraulic surplus in an average runoff scenario in relation to projected demand. With appropriate reservoir management this surplus will be used to counteract situations of low runoff but in high-runoff periods this surplus would be sold on surplus-energy markets.

In exceptional circumstances, the utility would also buy back dual-energy contracts. Other means, such as reserve thermal generating stations, additional reservoirs and extra purchases from neighboring systems have been considered but appear to be more costly. Technical and economic studies will be pursued to optimize energy-reserve criteria.

*Power Reserve*

Hydro-Québec is intensifying its generating-facilities maintenance programs to keep downtime to a minimum and achieve a high level of service quality.

Despite the broader scope of these programs, downtime due to failures and scheduled maintenance still occurs. A review of projected downtime has increased power-reserve needs by about 500 megawatts.

Hydro-Québec will also give itself an additional margin of manoeuvre of 500 megawatts of power reserve. This is essential to maintain quality of service and will give it more room to face contingencies on the power system. Hydro-Québec plans to attain this additional margin of manoeuvre by 1994. At that time, the required power reserve will be 4,500 megawatts, or a little more than 14% of demand. This amount covers uncertainties related to generating-facility downtime and demand.

**Facility-Selection Criteria**

To be able to supply electricity in a way that serves Québec's best interests, the utility takes into account the discounted cost of the construction program, environmental criteria, the need for flexibility and a realistic project schedule. It uses nominal and real discount rates of 11.5% and 6%, respectively.

*3.6.3 Installations Plan*

**Projects in Progress**

Commissioning of additional capacity at Manic 5 generating station will be completed in the winter of 1989-1990 and at La Grande 2 in 1991 and 1992. The direct-current transmission line from James Bay, the system's 11th line, will be in service in 1990. Because of additional power and energy requirements, Hydro-Québec has brought forward the commissioning of Phase II of the La Grande complex, and Brisay generating station will be available and integrated into the system by 1993. Laforge 1 and La Grande 1 generating stations will be commissioned in 1994. The north section of the 12th transmission line will be in service in 1993, and the south section in 1994. Lastly, the Manic 5 turbine runners will be upgraded from 1991 to 1994 to provide additional peak capacity.

**Average Demand-Growth Scenario**

*Future Projects*

In the 1990s, project lead times will limit the amount of energy that the utility can obtain from economically viable and environmentally acceptable projects. For example, the lead time required to make environmental studies, consult various interested parties including native communities, develop appropriate mitigative measures and obtain government authorizations precludes construction of major projects until 1998-1999, with the exception of the La Grande complex projects already in progress.

Commissioning of Laforge 2 and Eastmain 1 generating stations in 1995 and 1996 will complete the development of the La Grande complex. Commissioning of the Grande Baleine complex between 1998 and 2000 will involve construction of the 14th transmission line. Sainte-Marguerite generating station and the second section of the 13th transmission line from the North Shore will also be commissioned in 2000. The first generating stations of the Nottaway-Broadback-Rupert complex will be commissioned beginning in 2001, with subsequent commissionings adapted to needs. The 15th transmission line will be necessary for the commissioning of the first Nottaway-Broadback-Rupert generating stations.

Beyond the year 2000, Hydro-Québec must have enough flexibility to adapt to changing demand. Multiple-phase construction of the Nottaway-Broadback-Rupert complex meets this objective perfectly, because its almost 45 terawatthours of annual capacity can be commissioned in stages, as required. This complex represents almost 45% of the province's economically viable hydroelectric potential, and studies have shown that its construction can be adapted to changing demand.

The addition in 1992 and 1993 of more than 800 megawatts at La Citière and Bécancour gas-turbine stations will meet growth in power needs. On the 1996 and 1997 horizon, additional capacity at Manic 3 and Manic 2 stations will provide output carried on the first section of the 13th transmission line from the North Shore to load centres. Following this horizon, new base-load stations will meet peak-capacity needs.

For the construction schedule, it is essential that government authorizations be obtained within the specified time periods. A great many authorizations are required, as there are many different generating and transmission projects, spread out over a large portion of the province.

**Figure 3.8**
Energy Needs and Construction Program - Average Scenario

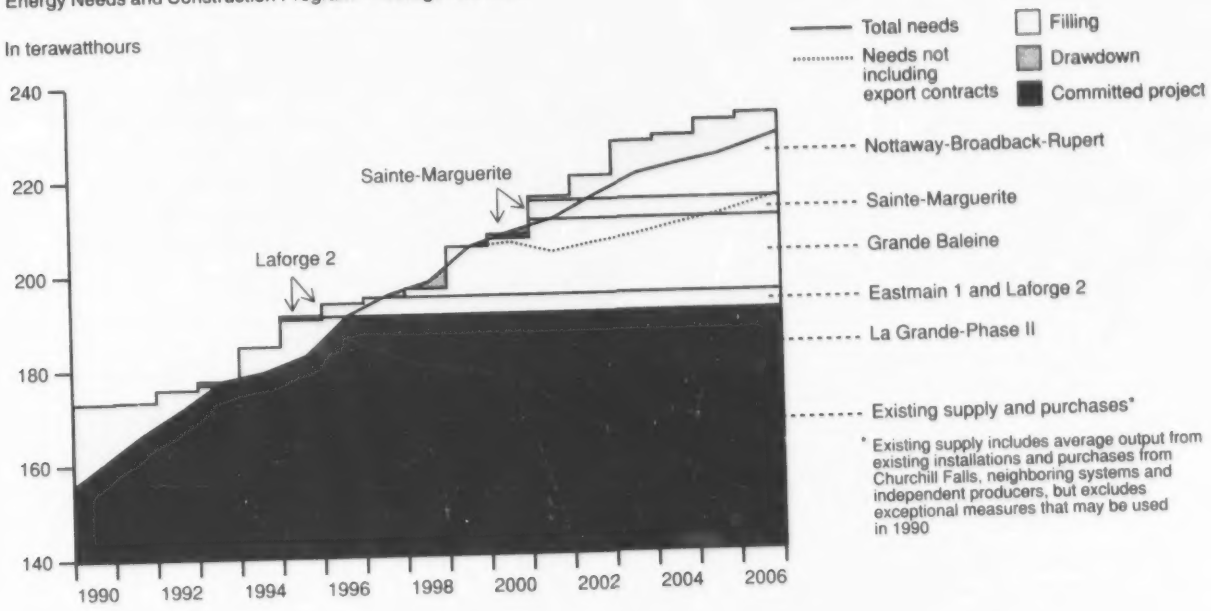



**Figure 3.9**
Power Needs and Construction Program – Average Scenario

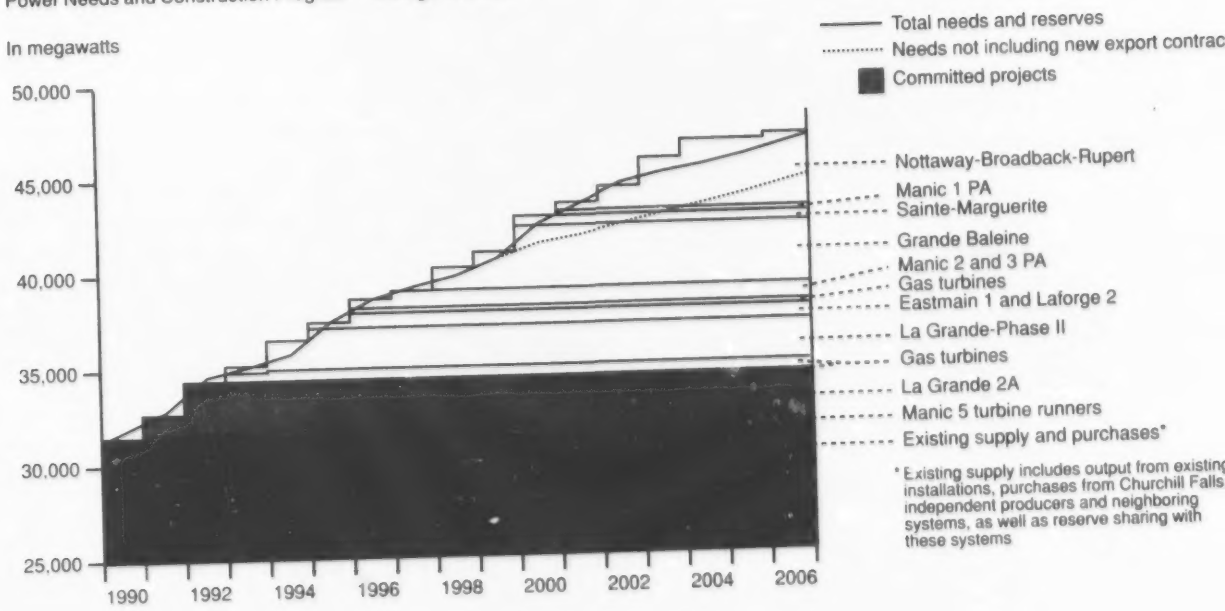


**Table 3.15**
Commissioning Dates for the Construction Program – Average Scenario

| | Available Power at Peak (in megawatts) | Commissioning | |
|---|---|---|---|
| | | Plan 1990-1992 | Plan 1989-1991 |
| **Projects in progress** | | | |
| • La Grande 2A | 1,900 | 1991-1992 | 1991-1992 |
| • 11th line: 450 kV DC | | 1990 | 1990 |
| • Radisson-Nicolet-des Cantons | | 1990 | 1990 |
| • Nicolet converter station | | 1992 | – |
| • Manic 5 turbine runners | 230 | 1991-1994 | 1994-1997 |
| LA GRANDE – PHASE II | | | |
| • La Grande 1 | 1,310 | 1994-1995 | 1994-1995 |
| • Laforge 1 | 820 | 1994 | 1995 |
| • Brisay | 380 | 1995 | 1995 |
| • 12th line: 735 kV AC | | 1993-1994 | 1994 |
| Additional capacity La Citière | 500 | 1992-1993 | |
| **Future projects** | | | |
| NORTHWEST | | | |
| • Laforge 2 | 270 | 1995 | 1996 |
| • Eastmain 1 | 470 | 1996 | 2004 |
| NORTH SHORE | | | |
| • Additional capacity at Manic 3, 2 and 1 | 1,120 | 1996-97-2001 | 1997-2003 |
| • Sainte-Marguerite | 800 | 2000 | 1998 |
| • 13th line: 735 kV AC | | 1996-2000 | 1997-1998 |
| GRANDE BALEINE COMPLEX | | | |
| • Grande Baleine 1, 2 and 3 | 3,060 | 1998-2000 | 1998-2000 |
| • Integration at 315 kV | | 1998-2000 | – |
| • 14th line: 735 kV AC | | 1998 | 1998 |
| ASHUAPMUSHUAN COMPLEX | 730 | * | 2000-2001 |
| NBR COMPLEX | | | 2004-... |
| • NBR 1 | 2,500 | 2001-2003 | |
| • NBR 2 | 2,400 | 2002-2007 | |
| • NBR 3 | 1,500 | 2006-... | |
| • NBR 4 | 2,000 | * | |
| • 15th line: 735 kV AC | | 2001 | 2004 |
| **Other installations** | | | |
| • Peaking plant | 550 | 1992-1993-96 | 1992-93 |
| • Lévis-des Cantons line: 735 kV AC | | 1995 | 1995 |

* Commissioning after 2006.

*Investment*

Construction and rehabilitation of generating and transmission facilities in the average-demand scenario will require investment of $45 billion, for the period 1990-1999. Major projects in progress will cost an estimated $6 billion for generation and $2 billion for transmission over the same period.

## Supply-Demand Balance

Table 3.16 shows the balance in electricity supply and demand taking the projected commissionings of new generating facilities into account. It indicates the best planning of supply to reliably satisfy Québec's firm-energy needs and Hydro-Québec's contractual commitments. Total supply includes hydroelectric and thermal generation and electricity deliveries, primarily from Churchill Falls.

**Table 3.16**
Electrical Energy Balance Sheet*
(in terawatthours)

| | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Supply** | | | | | | | | | | | | |
| Hydroelectric generation | | | | | | | | | | | | |
| • runoff** | 139.0 | 133.3 | 164.4 | 165.6 | 166.0 | 167.0 | 173.8 | 180.2 | 182.7 | 184.5 | 186.3 | 195.0 |
| • variation (drawdown +, accumulation –) | 16.2 | 11.1 | –22.8 | –7.1 | –4.2 | –0.1 | –5.3 | –8.3 | –2.3 | 0.9 | 1.7 | 0.4 |
| • spillage | –1.5 | –1.9 | – | – | – | – | – | – | – | – | – | – |
| **Total** | 153.7 | 142.5 | 141.6 | 158.5 | 161.8 | 166.9 | 168.5 | 171.9 | 180.4 | 185.4 | 188.0 | 195.4 |
| • Nuclear (Gentilly 2) | 5.6 | 5.2 | 4.9 | 3.7 | 5.0 | 4.8 | 4.7 | 4.7 | 4.7 | 4.7 | 4.7 | 4.7 |
| • Tracy (oil-fired) and gas turbines | 0.2 | 1.5 | 2.6 | – | – | – | – | – | – | – | – | – |
| • isolated systems | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| **Total** | 6.0 | 6.9 | 7.7 | 3.9 | 5.3 | 5.1 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Electricity received (agreements and purchases) | 4.0 | 7.6 | 7.4 | 4.0 | 4.9 | 5.8 | 6.2 | 6.2 | 6.2 | 5.5 | 5.5 | 5.5 |
| **Total supply = Needs to be met** | 163.7 | 157.0 | 156.7 | 166.4 | 172.0 | 177.8 | 179.7 | 183.1 | 191.6 | 195.9 | 198.5 | 205.9 |

* The figures in this table have been rounded off. As a result, when added, they may differ from the total shown.
** Real figures for 1988 and 1989 and averages for the other years. They include Churchill Falls.

**Flexibility of Adaptation to Various Demand Scenarios**

To meet demand, Hydro-Québec must react to a changing environment, adapting to growth that is either higher or lower than forecast. The challenge ahead is to have the flexibility required to adapt to long lead times while ensuring the sustainable development of hydroelectric resources.

The utility bases the construction schedule of its new installations on the average-demand scenario. However, given the time required for studies, consultation and construction, it is easier to adjust the construction program downward rather than upward, so the utility plans its studies and applications for government authorization using the strong-demand scenario. Any decision to begin construction is only made after authorizations have been obtained, based on the most recent demand forecasts.

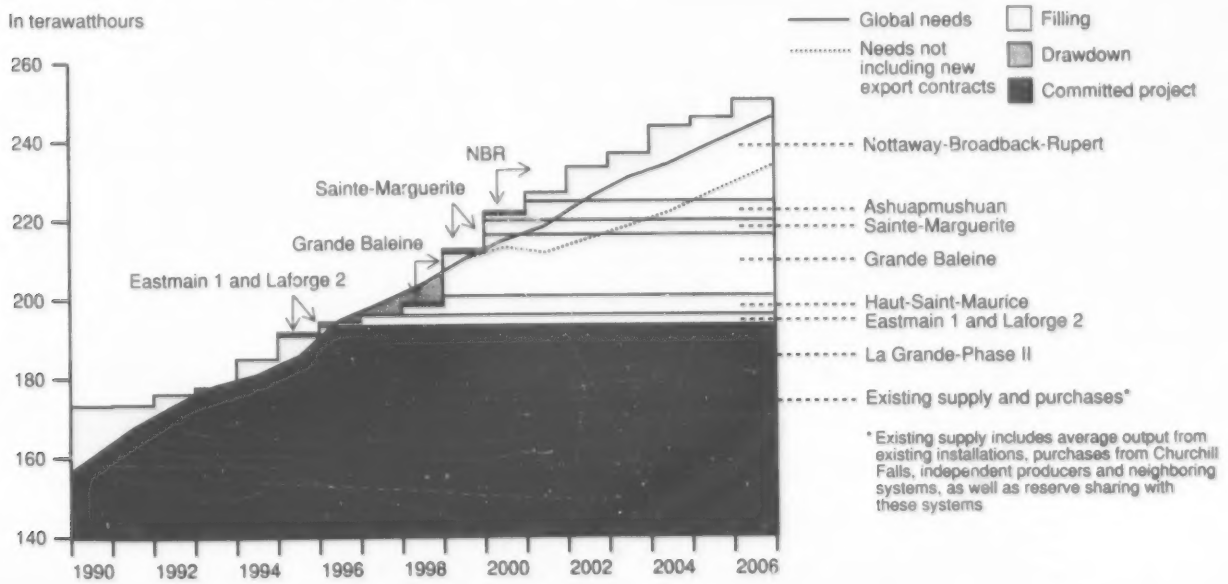
Table 3.17 shows the commissioning dates for the three demand scenarios.

*High-Demand Scenario*

In a high-demand scenario, all projects would be brought forward to their earliest commissioning dates, additional output would be purchased from independent producers and energy conservation would be stepped up. This scenario calls for construction of all economically viable projects within 25 years. Construction of the Grande Baleine complex would be brought forward to 1998-1999. Sainte-Marguerite generating station would be commissioned in 1999, the generating stations in the Ashuapmushuan complex in 1999, and the station on the Haut-Saint-Maurice in 1998. Commissioning of the Nottaway-Broadback-Rupert complex would begin as planned in 2000, following a compressed nine-year timetable.

In the medium term, in addition to these hydroelectric projects, Hydro-Québec might have to build additional thermal generating plants to ensure reliable supply, should some projects be delayed.

**Figure 3.10**
Energy Needs and Construction Program – High-Demand Scenario



*Low-Demand Scenario*

In the low-demand scenario, only the costs of performing these studies and constructing access roads to the sites would be incurred, and the utility could postpone major construction for a number of years.

**Table 3.17**
Construction Program According to Various Québec Demand Scenarios

| | Demand Scenario | | |
|---|---|---|---|
| | **Average** | **High** | **Low** |
| **Projects in progress** | | | |
| • La Grande 2A | 1991-1992 | 1991-1992 | 1991-1992 |
| •. 11th line: 450 kV DC | 1990 | 1990 | 1990 |
| • Radisson-Nicolet-des Cantons | 1990 | 1990 | 1990 |
| • Nicolet converter station | 1992 | 1992 | 1992 |
| • Manic 5 turbine runners | 1991-1994 | 1991-1994 | 1991-1994 |
| LA GRANDE – PHASE II | | | |
| • La Grande 1 | 1994-1995 | 1994-1995 | 1994-1995 |
| • Laforge 1 | 1994 | 1994 | 1994 |
| • Brisay | 1993 | 1993 | 1993 |
| • 12th line: 735 kV AC | 1993-1994 | 1993-1994 | 1993-1994 |
| Additional capacity at La Citière | 1992-1993 | 1992-1993 | 1992-1993 |
| **Future projects** | | | |
| NORTHWEST | | | |
| • Laforge 2 | 1995 | 1995 | 2000 |
| • Eastmain 1 | 1996 | 1996 | – |
| NORTH SHORE | | | |
| • Additional capacity at Manic 3, 2 and 1 | 1996-97-2001 | 1995-1996 | 2000-2001 |
| • Sainte-Marguerite | 2000 | 1999 | – |
| • 13th line: 735 kV AC | 1996-2000 | 1995-1999 | 2000 |
| GRANDE BALEINE COMPLEX | | | |
| • Grande Baleine 1, 2 and 3 | 1998-2000 | 1998-1999 | 2005-... |
| • Integration at 315 kV | 1998-2000 | 1998-1999 | 2005-... |
| • 14th line: 735 kV AC | 1998 | 1998 | 2005-... |
| HAUT-SAINT-MAURICE | • | 1998 | – |
| ASHUAPMUSHUAN COMPLEX | • | 2000 | – |
| NBR COMPLEX | | | |
| • NBR 1 | 2001-2003 | 2000-2002 | – |
| • NBR 2 | 2001-2007 | 2002-2004 | – |
| • NBR 3 | 2006-... | 2004-... | – |
| • NBR 4 | • | 2004-... | – |
| • 15th line: 735 kV AC | 2001 | 2000 | – |
| **Other installations** | | | |
| • Peaking plant | 1992-93-96 | 1992-93-96-97 | 2000-... |
| • Lévis-des Cantons line: 735 kV AC | 1995 | 1995 | 1995 |

• Commissioning after 2006.

*3.6.4 Program of Studies*

Hydro-Québec will continue studies on Laforge 2, Eastmain 1, Grande Baleine, Sainte-Marguerite, Ashuapmushuan, Haut-Saint-Maurice and Nottaway-Broadback-Rupert to be able to meet a high-demand scenario.

Decisions regarding construction of Laforge 2, Sainte-Marguerite and the Grande Baleine complex should be taken this year. Studies on the Ashuapmushuan and Haut-Saint-Maurice projects will give the utility the flexibility required to meet a strong increase in demand.

Through its 1990 program of studies, Hydro-Québec will maximize its information on projects representing economically viable hydroelectric potential. Still, in the long term other sources may replace hydroelectricity, so the utility will update information on the costs of nuclear energy and study a combined-cycle gas-turbine generating station.

A preliminary study will also be made to evaluate the residual potential of the Péribonka River.

With respect to peaking facilities, early in the 1990s Hydro-Québec will begin installing additional gas turbines at La Citière and Bécancour. Studies of additional capacity at Manic 3 and Manic 2 will also continue in 1990.

**Decision Timetable and Applications for Government Authorizations**

*Hydroelectric Facilities*

The schedule for realization of the hydroelectric developments required according to the average-demand scenario is shown in Figure 3.11.

The schedule retained for the Grande Baleine complex offers little margin of manoeuvre because of the lead time required to make a rigorous impact-assessment study and obtain government authorizations.

Discussions are now under way between the federal and Québec governments regarding harmonization of the various study, review and approval procedures applicable to Grande Baleine, particularly the procedure specified in the James Bay and Northern Québec Agreement. Moreover, Hydro-Québec has begun negotiations with Native Peoples to find joint solutions to the environmental, social and economic issues related to the project.

In fact, the draft-design study of the Grande Baleine complex includes two impact-assessment studies. The first concerns access infrastructure and the second, the hydroelectric complex itself.

In the case of access infrastructure, Hydro-Québec expects to obtain a revised directive from the Environment Minister in the spring of 1990 and to submit its draft-design report, including the impact-assessment study, in the summer of 1990. This will enable the utility to obtain government authorizations in the fall of 1990 and finish construction of the LG2-GB1 road section at the end of 1992.

With respect to the hydroelectric complex, the revised directive from the Environment Minister should also be issued in the spring of 1990. The draft-design report and impact-assessment study will be submitted to the government in the fall of 1990 so that authorization can be obtained in early 1992. Commissioning of the complex will take place from 1998 to 2000.

The schedules for Laforge 2 and Eastmain 1 stations are also tight.

Hydro-Québec will apply for, and hopes to obtain, a sectorial authorization for access infrastructure for the Sainte-Marguerite project in 1990. Authorizations for the hydroelectric project itself should be obtained in the fall of 1991.

The Ashuapmushuan and Haut-Saint-Maurice projects are not required in an average scenario but the utility will pursue studies to ensure the flexibility required to meet a larger increase in demand.

**Figure 3.11**
Decision Timetable for Base-Load Generating Stations – Average Scenario

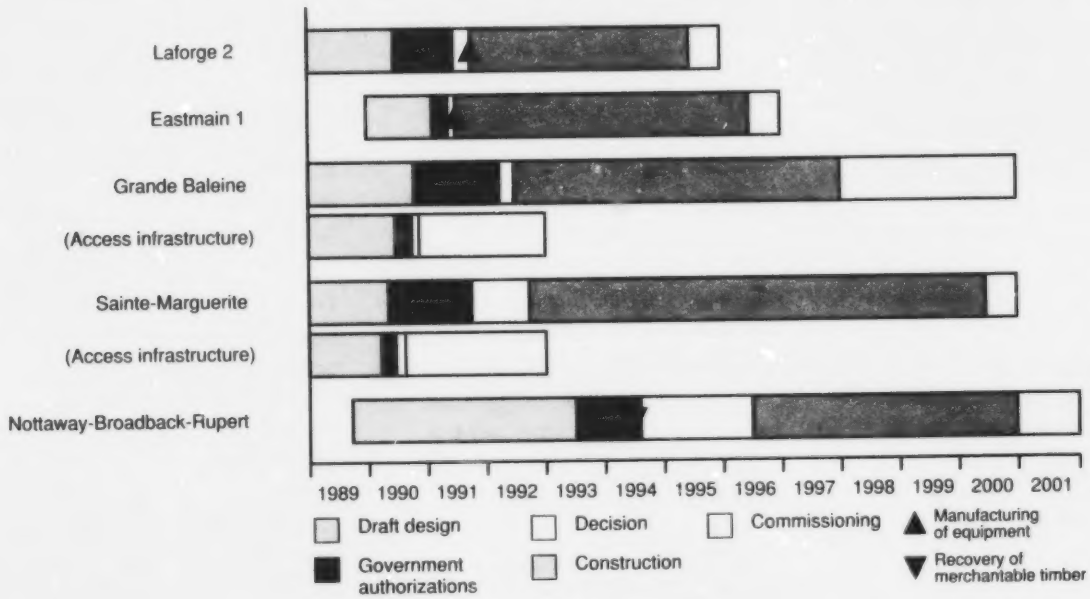
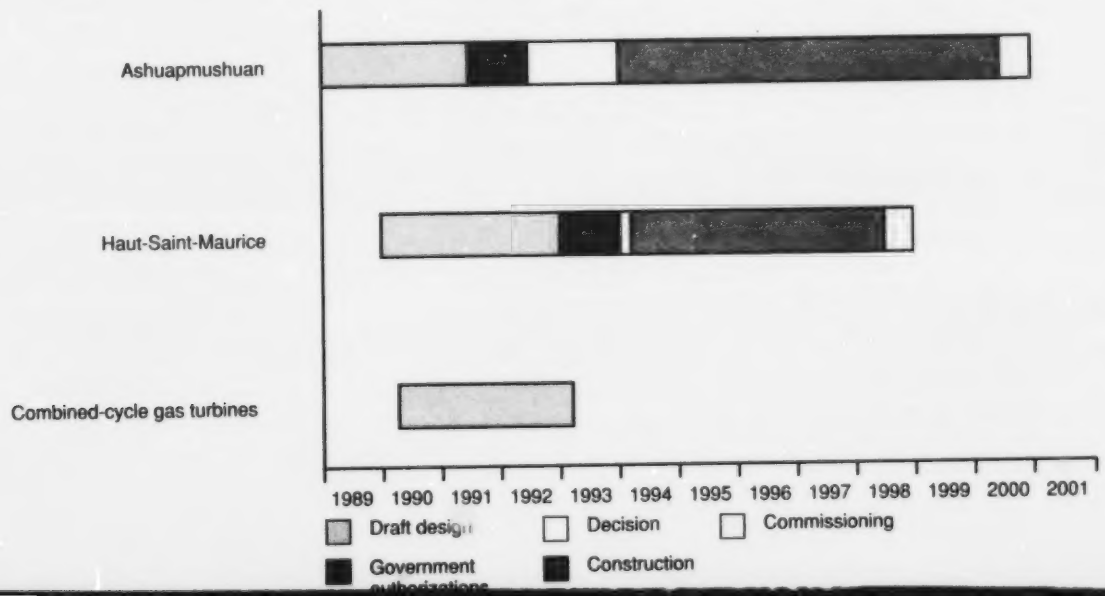



**Figure 3.12**
Decision Timetable for Generating Stations Under Study - High-Demand Scenario



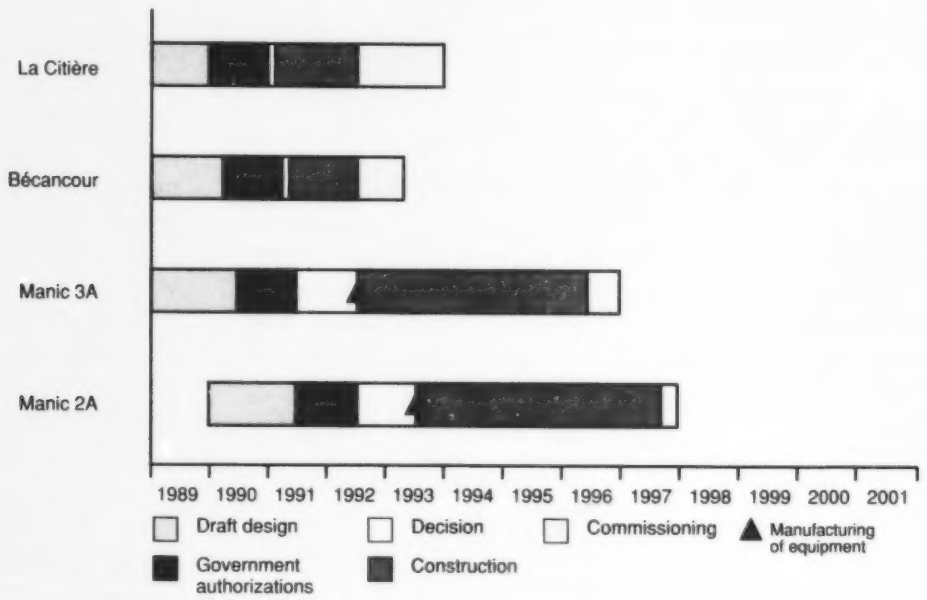
*Peak-Load Thermal Facilities*

The schedule for peak-load gas-turbine projects is also tight, both at La Citière and Bécancour, so the procurement process for the turbine-generator units will take place at the same time as the utility applies for government authorizations.

The contract for the manufacture of the turbine-generator units will have to be awarded in the summer of 1990, although the government authorizations will not be obtained until early in 1991.

If these deadlines are not respected, the gas-turbine stations will not be available for the 1992-1993 winter peak, and power reliability will be significantly affected.

**Figure 3.13**
Decision Timetable for Peaking Plant – Average Scenario



### *3.6.5 Project-Approval Procedure*

**Current Québec Procedures**

Hydro-Québec's projects must be examined and approved by the Québec government prior to realization. Like other projects, they are governed by the *Environment Quality Act*, the *Act respecting land use planning and development*, and the *Act to preserve agricultural land*. The utility must also obtain prior authorizations under its own *Hydro-Québec Act*.

The *Environment Quality Act* applies to Québec as a whole. It sets out two separate regimes, however, for the evaluation and review of the environmental impacts of projects, depending on whether or not these projects are in the territory covered by the James Bay and Northern Québec Agreement. Tables 3.18 and 3.19 show the authorizations required at the various stages of study and construction, under the two regimes.

**Harmonization of Procedures**

Hydro-Québec's projects must comply with many laws and regulations, each with its own authorization procedures. These procedures are lengthy and complex, and are carried out simultaneously. They involve a number of government bodies, which are not obliged to coordinate their activities and whose schedules vary according to their workloads. Only the time periods allowed the *Bureau d'audiences publiques sur l'environnement* (Environmental Public Hearings Board – BAPE) for public information and consultation and for public hearings are set out in the *Environment Quality Act*.

Thus far Hydro-Québec has planned its commissioning dates according to schedules agreed with the Québec government. Failure to respect these schedules would delay commissionings and could affect Hydro-Québec's ability to meet long-term electricity demand.

The obtaining of timely government authorizations so as to respect the commissioning dates in the Installations Plan is a very real constraint. It is therefore necessary to harmonize the various procedures for obtaining government authorizations.

The Québec government, as stated in its 1988 energy policy, is now studying ways of improving the review and authorization procedures for Hydro-Québec's projects, both on treaty and non-treaty land. The purpose is to ensure better integration of economic, technical and environmental considerations, on the basis of rigorous impact-assessment studies, and to determine how long each stage of the procedures under the two regimes should last.

On the basis of applicable federal laws and recent environmental decisions by the Federal Court of Canada, the federal government has informed the Québec government and Hydro-Québec that it intends to apply the federal environmental evaluation and review procedure to the Grande Baleine project. The terms of application of this procedure will be contained in an agreement to be reached between the federal government, the provincial government and the Native Peoples concerned.

**Table 3.18**
Québec Authorization Procedure (Excluding Territory Covered by the JBNQA*)

| PROJECT PHASE | AUTHORIZATIONS | | | |
|---|---|---|---|---|
| | ***Ministère de l'Énergie et des Ressources*** | ***Ministère de l'Environnement*** | ***Commission de la protection du territoire agricole du Québec* (CPTAQ)** | **Regional County Municipalities (RCMs)** |
| **Beginning of draft design** | Decree authorizing draft design | Minister's directive regarding impact-assessment study | | |
| **End of draft design** | Decree authorizing expropriation and construction | Public information and consultation (45 days)<br>↓<br>BAPE public hearing (4 months, if required)<br>↓<br>Decree authorizing issuance of an authorization certificate<br>↓<br>Authorization certificate issued by the Environment Minister | CPTAQ Public hearing (if required)<br>↓<br>CPTAQ decision | Compliance notice from RCMs concerned<br>OR<br>Notice from the *Commission municipale du Québec*<br>OR<br>Procedure to amend the development plans of the RCMs concerned |
| **Realization** | | Authorization certificates issued by the Environment Minister for certain project components (quarries, camps, etc.) | CPTAQ public hearing (if required)<br>↓<br>CPTAQ decision approving siting of structures | |

* James Bay and Northern Québec Agreement.

**Table 3.19**
Québec Authorization Procedure (Territory Covered by the JBNQA* )

| PROJECT PHASE | AUTHORIZATIONS | | |
|---|---|---|---|
| | ***Ministère de l'Énergie et des Ressources*** | ***Ministère de l'Environnement (Administrator of the JBNQA)*** | |
| | | **South of the 55th parallel** | **North of the 55th parallel** |
| **Beginning of draft design** | Decree authorizing draft design | Recommendations by the Review Committee of the Environment Minister on the nature and scope of the impact-assessment study<br>↓<br>Minister's directive regarding the impact-assessment study | Recommendations by the KATIVIK Environmental Quality Commission to the Environment Minister on the content and scope of the impact-assessment study<br>↓<br>Minister's directive regarding the impact-assessment study |
| **End of draft design** | Decree authorizing construction and acquisition of immovable property in the public domain and necessary property rights | Analysis of the impact-assessment study by the Review Committee, with oral or written representations by the Cree Regional Authority, bands, village corporations or individuals<br>↓<br>Recommendations by the Review Committee to the Environment Minister regarding project authorization and realization<br>↓<br>Certificate of authorization issued by the Environment Minister | Analysis of the impact-assessment study by the KATIVIK Environmental Quality Commission, with written representations from interested municipalities, groups or individuals.<br>↓<br>Decision by the KATIVIK Environmental Quality Commission regarding project authorization by the Environment Minister and realization<br>↓<br>Certificate of authorization issued by the Environment Minister |
| **Realization** | | Certificates of authorization issued by the Environment Minister for certain project components (quarries, camps, etc.) | Certificates of authorization issued by the Environment Minister for certain project components (quarries, camps, etc.) |

* James Bay and Northern Québec Agreement.

# 4

# ENVIRONMENTAL PROTECTION AND ENHANCEMENT

Over the past 20 years the Environment function has expanded at Hydro-Québec, and environmental concern has been integrated into the utility's various activities. There are now a considerable number of Hydro-Québec managers, specialists, engineers, technicians and trades employees in all fields who have the specific mandate of ensuring environmental protection and enhancement.

**Environmental Orientations**

Hydro-Québec is concerned about respecting Québec's changing environmental values, while at the same time remaining in the forefront of environmental progress in the province. These are the main factors which have shaped the utility's environmental decisions in the past 20 years and which, in the years to come, will ensure environmental protection and enhancement, as well as integration of the sustainable-development concept into Hydro-Québec's activities and projects.

For 1990-1992, Hydro-Québec has adopted seven main environmental orientations, described in the sections that follow. The complementary document *Hydro-Québec and the Environment* provides further details on the utility's environmental activities.

Hydro-Québec's environmental team in 1990 comprises 143 permanent and temporary employees at the *vice-présidence Environnement* (Environment Branch), 10 employees at *Société d'énergie de la Baie James* (SEBJ) and 57 employees in the various regions. The services of outside specialists and university researchers are also retained, for a total of about 370 person-years.

## *4.1 Operation of Existing Installations*

| Objectives | Strategies |
|---|---|
| Manage contaminants | Plan of Action Concerning PCBs<br>Site-specific maintenance of rights-of-way<br>Plan of action for contaminants<br>Studies of pentachlorophenol and chlorofluorocarbons |
| Improve existing facilities and properties from the environmental standpoint | Preparation and implementation of a second three-year program (1990-1992)<br>Plan of action for noise created by existing facilities |
| Ensure environmental integration of the distribution system | Studies of the system's effects on various environments<br>Environmental-evaluation pilot projects in each administrative region<br>Corporate guidelines |
| Train and sensitize employees | Training sessions<br>Awareness activities |

### *4.1.1 Management of Contaminants and Hazardous Waste*

The operation and maintenance of Hydro-Québec's facilities entails the use of various products and thus creates waste, some of which may be hazardous to the environment.

Most of the objectives retained for 1990-1992 are not new. They are a continuation of the measures that Hydro-Québec has taken since late in the 1970s, when governments decided to ban polychlorinated biphenyls (PCBs).

#### Plan of Action Concerning PCBs

Hydro-Québec adopted its *Plan of Action Concerning PCBs* in 1985. The plan's objective is to remove all PCBs from the generating, transmission and distribution system and eliminate them, by 1995. Table 4.1 summarizes the results obtained at the end of 1989.

**Table 4.1**
Results of the *Plan of Action Concerning PCBs* since 1985

| |
|---|
| 80% of transformers and 75% of capacitors have been removed from the system. |
| 16% of contaminated oil has been decontaminated (2.4 million litres of a total of 15 million litres). Decontaminated oil measuring from 2 to 50 ppm is destroyed, whereas that containing less than 2 ppm is reused. |
| 325 tonnes of PCBs and of PCB-contaminated products were destroyed in Great Britain prior to August 1989, of the 3,500 tonnes to be destroyed. |
| 40 storage sites comply with new provincial regulations. |

An intensive program to decontaminate oil in existing equipment will be carried out in the next few years. Hydro-Québec is also actively involved in research to develop a destruction technology that meets Québec's needs.

While waiting for a means to destroy the PCBs, Hydro-Québec stores them and equipment that contains PCBs at some 40 storage sites at its installations. These sites comply with the new provincial regulations. The utility plans to develop a total of 48 sites that comply with the regulations. This will enable it to close down gradually several of the sites already used for temporary storage.

**Right-of-Way Maintenance and Herbicides**

Although the utility accounts for less than 2% of the herbicides used in Québec, it is adopting other methods of controlling vegetation (biological control, seeding of herbaceous species, etc.) as it studies their effects on the environment and develops the appropriate protective measures. Hydro-Québec's approach is to use and develop site-specific vegetation-control methods, taking into account their effectiveness and their impacts on the environment and worker health and safety.

**Other Contaminants**

Hydro-Québec is developing a plan of action for more efficient management of the other contaminants it must use, taking into account the various stages of their life cycles (purchase and selection of products, storage, use, handling, transportation and elimination). This plan of action covers a group of products used on a day-to-day basis, such as solvents, paints, detergents and certain petroleum products.

Hydro-Québec has about 1.5 million poles treated with pentachlorophenol (PCP), which have a service life of 30 to 35 years. In 1989, the utility began a study program to determine the real impacts of this product and find substitutes, if necessary.

Chlorofluorocarbons (CFCs) and halons are used in fire-protection systems. Given their destructive effect on the ozone layer, the utility will carry out studies with a view to adopting practices that eliminate or limit the use of these compounds.

**Contaminated Sites**

Hydro-Québec's contaminated sites are managed on a case-by-case basis, because the best means of restoring them must be determined individually. For example, decontamination work has begun both on the Magdalen Islands, where groundwater was polluted by fuel used at Cap-aux-Meules generating station, and at the site of the former gas-fired plant on Verdun Street in Québec City, where the soil was contaminated prior to its acquisition by Hydro-Québec in 1963.

### *4.1.2 Environmental Improvements in Existing Facilities*

**Three-Year Mitigative and Improvement Program**

In 1986, Hydro-Québec implemented a program called the Plan and Review of Environmental Improvements in Facilities and Properties. This three-year mitigative and improvement program is set out in Principle 3 of *Hydro-Québec's Environment Policy*. It ended in 1989, and $127 million (at December 31, 1989) had been spent on improving the environmental performance of existing facilities. The initial evaluation of the program has confirmed its effectiveness, and a new three-year program will be designed and implemented from 1990 to 1992.

**Reservoir Management**

Hydro-Québec takes action on a case-by-case basis to solve problems relating to reservoir management. An inventory of complaints was recently compiled in order to define the expectations of communities neighboring the reservoirs and to plan an appropriate study program.

**Noise**

Hydro-Québec is currently developing a long-term plan of action to implement remedial measures at existing facilities in order to lower noise levels in locations where they are considered excessive or to lower or maintain noise levels at rehabilitated facilities.

The utility's objective is to meet provincial and municipal noise standards, even when they do not apply to existing facilities, provided they are economically feasible.

### *4.1.3 Integration of the Distribution System into Various Environments*

In recent years, Hydro-Québec has completed a large number of studies on the distribution system's effects on various environments, such as urban areas, resort areas, heritage areas and scenic routes. These studies have led to implementation of effective measures that integrate the components of the distribution system into the landscape.

While continuing with this study program, Hydro-Québec is incorporating an environmental approach into the building of its distribution systems. In the short term, each of the utility's administrative regions will carry out a pilot environmental-evaluation project on integrating the distribution system into its surroundings. The results will be used to establish corporate guidelines.

### *4.1.4 Training and Sensitizing Operations Employees*

Training employees and sensitizing them to the environmental aspect of their activities will be a management challenge in the next three years. This is one of the utility's preferred methods of ensuring that *Hydro-Québec's Environment Policy* is applied and that all employees take the environment into account at their places of work.

The utility will continue its training sessions and awareness activities, investing nearly $1.3 million in this area from 1990 to 1992.

## *4.2 Planning and Construction of New Installations*

| Objectives | Strategies |
|---|---|
| Plan and construct installations while taking the environment into account | Study on the cumulative environmental effects of the Installations Plan<br>Determination of the environmental issues relating to projects<br>Impact-assessment studies and development of mitigative measures<br>Environmental monitoring and follow-up<br>Scientific and technological research on the environment |
| Broaden construction strategies to enhance the positive spinoffs of projects | Strategies adapted to each project to work in concert with the communities affected to promote their social and economic development |

### *4.2.1 Study and Implementation Process*

From the planning to the operation of a new installation, the study and implementation process for Hydro-Québec's projects consists of several stages. Table 4.2 shows the integration of environmental considerations into each stage.

**Study of Cumulative Environmental Effects**

The study of cumulative environmental effects is integrated into the strategic planning of installations. The initial results were used to prepare Hydro-Québec's Installations Plan.

**Impact-Assessment Studies**

Ever since Hydro-Québec began carrying out impact-assessment studies more than 15 years ago, they have been included as part of the utility's draft-design studies.

Since 1987, draft-design studies have been carried out in two separate phases, each comprising important information and consultation activities. This approach enables the utility to work more closely with the populations affected, determine the value they place on the resources in their environment, orient studies and decisions accordingly and optimize the mitigative measures required.

Impact-assessment studies cannot be dissociated from the planning, design and implementation of a project, as the technical, economic and environmental aspects of these stages are all interdependent.

To carry out these studies, Hydro-Québec has set up a large team of environmental managers and specialists. It also retains the services of a large number of consultants, such as university researchers and specialists employed by consulting firms noted for their environmental expertise. And for certain projects, Hydro-Québec sets up scientific committees comprised of outside experts.

**Table 4.2**
Study and Implementation Process

| Stages | Studies and Activities | Objectives |
|---|---|---|
| **Preparation of Installations Plan**<br>Selection of generating and transmission facilities required to supply electricity to Québec and external markets as a function of demand | Study of cumulative environmental effects | Integrate environmental feasibility of the Installations Plan into its technical and economic feasibility<br>Orient the utility's choices regarding installations planning<br>Orient the environmental content of preliminary and draft-design studies |
| **Preliminary studies**<br>Initial evaluation of the project's technical, economic and environmental feasibility<br>Establishment of generating-facility development concepts or transmission-system supply scenarios | Identification and analysis of environmental issues relating to projects | Identify environmental advantages and problems that may affect project feasibility<br>Provide environmental input to establish development concepts or supply scenarios |
| **Draft-design studies**<br>Phase 1 of draft design (determination of project feasibility):<br>– generating facilities: selection of development option<br>– transmission facilities: corridor selection<br>Phase 2 of draft design:<br>– generating facilities: optimization of option retained<br>– transmission facilities: route selection | Impact-assessment studies<br>Specific information on the environment<br>Studies of development concepts or options<br>Identification and evaluation of impacts<br>Information and consultation with bodies concerned<br>Detailed assessment of impacts<br>Development of mitigative measures<br>Informing and consulting with populations concerned about the solution adopted | Perform impact-assessment study required pursuant to the *Environment Quality Act* and the directive of the Minister of the Environment<br>Consult with communities concerned<br>Develop required mitigative measures<br>Obtain government authorizations |
| **Engineering and Construction** | Environmental monitoring<br>Contractor training and sensitization<br>Environmental follow-up<br>Environmental-enhancement program<br>Informing populations concerned | Integrate mitigative measures and other environmental conditions into plans and specifications<br>Ensure respect for the Environment Code and other Hydro-Québec environmental guidelines<br>Measure real impacts of project<br>Evaluate the performance of mitigative measures and optimize them<br>Take advantage of opportunities created by the project to enable the communities affected to participate in restoration of environmental balance disrupted by the project, in order to develop the area's biophysical resources and therefore meet community needs and objectives |
| **Operations** | Environmental follow-up | |

**Environmental Follow-up**

The results of environmental follow-up are used not only for project optimization but also to improve impact-assessment methods and mitigative measures for future projects. Thus, in certain instances environmental follow-up takes place over very long periods, such as the La Grande complex environmental follow-up network, which began in 1978.

*4.2.2 Environmental Feasibility of the Installations Plan*

Hydro-Québec's generating and transmission facilities occupy 1% of Québec (1.5 million square kilometres). Construction of all projects included in the economically feasible potential of 18,800 megawatts could double the area occupied. The utility thus has a clear responsibility to protect and enhance the environment.

The initial results of the study of cumulative environmental effects show that, given current knowledge, construction of the projects in the economically viable potential will not have major effects on the climate, underground water tables, wildlife resources and habitats, or estuarine environments. This first conclusion takes into account the fact that each project will receive a rigorous impact-assessment study and appropriate mitigative measures. Certain general studies of these issues must also be continued in order to provide basic information and specialized methods to be used in each project's impact-assessment studies.

Nevertheless, interactions between resources and their users mean that these projects are likely to have cumulative effects in three areas of the human environment: organization and structure of the area; regional economies; and local lifestyles. These effects will be significant. Mitigating and managing them will require increased collaboration with communities affected, beyond that already included in the impact-assessment and draft-design studies.

Moreover, Hydro-Québec is not the only land user or developer. Environmental protection and enhancement are concerns that must be shared by other users, resource developers and land-use planners and developers.

The utility has therefore decided to broaden its project-implementation strategy to place greater emphasis on social and economic considerations in the environments concerned, in keeping with a multifunctional approach that will enhance the positive spinoffs of its projects.

## The Native Peoples

The development of La Grande, which began in 1972, took place within the framework of the James Bay and Northern Québec Agreement. This major hydroelectric project, completed with the continuous help of local representatives, had many positive effects.

The Cree population of the area rose from 7,000 in 1976 to 10,300 in 1988. Moreover, it has been able to form, within its community, an increasingly qualified pool of manpower. In fact, during the construction of Phase I of the La Grande complex, the Cree population supplied 200,000 person-days of work. When construction was at its height, 522 Cree were working on the site.

The James Bay Agreement provides for an income-security program designed to preserve the traditional Cree economy based on hunting, fishing and trapping. Under this program, Québec paid out nearly $12 million in guaranteed income during the 1987-1988 fiscal year alone, or nearly $10,000 per family.

For the development of La Grande, 1,530 kilometres of roads and many dams and dikes were built. These also serve the population of the region, providing easier access to remote trapping areas. Furthermore, construction of the road between Matagami, La Grande 2 and Chisasibi has allowed a wider distribution of goods, which has helped lower their cost. And since the signing of the Agreement in 1975, most villages have been electrified and are supplied by Hydro-Québec.

The development of this region has also led to the formation of Cree businesses. During the 1988-1989 fiscal year, these businesses signed contracts with Hydro-Québec and SEBJ totalling some $30 million.

Moreover, to facilitate the integration of new Cree personnel into its operating activities, the utility has launched a training program which will continue over the next few years. By 1996, Hydro-Québec will have hired some 150 Cree as permanent employees.

However, the utility's projects in the areas where the native peoples live have significant impacts on their way of life and on the economic and social structures of their communities. Initially, these impacts are due to the presence of large numbers of construction workers who change the interactions between the native and white communities. The access roads that Hydro-Québec requires to construct the projects also promote greater accessibility to the region during and after construction.

While the Nottaway-Broadback-Rupert and Grande Baleine projects will have an impact on the Cree and Inuit residents of James Bay and Hudson Bay, the Sainte-Marguerite and Ashuapmushuan projects will also affect the fishing, hunting and trapping activities of the Montagnais. Furthermore, the Haut-Saint-Maurice development will flood 10% of the Atikamek reserve, Weymontachie.

All necessary measures will be taken to ensure that native peoples are involved in the project's development and that they benefit from its direct and indirect economic spinoffs, both during and after construction. Collaboration with native peoples will aim to create economic and social development in their communities according to their needs, so that they can also pursue their traditional activities.

### *4.2.3 Environmental Issues Related to Major Projects*

The study of cumulative environmental effects and preliminary and draft-design studies demonstrate the environmental problems associated with the Installations Plan. The various environmental issues pertaining to projects in the Installations Plan are outlined in Table 4.3.

It should be noted that, in phase I of the development of the *La Grande Rivière*, Hydro-Québec and SEBJ have allocated some $250 million to environmental studies and measures, which is nearly 2% of the total construction cost. Mitigative measures comprise, among others, seeding of river banks, construction of a fish ladder, planting of nine million trees and shrubs, and cutting and clearing of forest debris.

**Mercury**

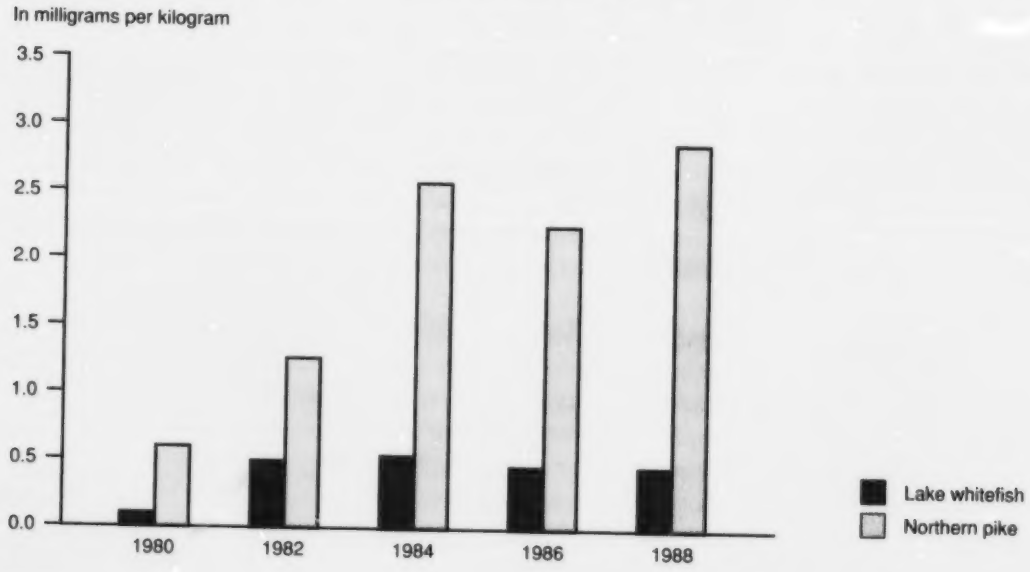
The problem of mercury is one of the most important environmental issues, as it arises in the development of all reservoir-type hydroelectric generating stations. Geological in origin, mercury is released into the environment by complex biogeochemical processes that occur when reservoirs are impounded.

The La Grande complex is an example that has made it possible to better understand this phenomenon. A follow-up of mercury concentrations in the flesh of fish in the La Grande reservoirs began in 1978. The results show that concentrations increase rapidly after impounding, but level off after six or seven years. The phenomenon is therefore temporary, and extrapolations based on follow-up results show that the concentrations return to normal 10 or 15 years after levelling off. It should also be noted that predatory fish, which native peoples are partial to, accumulate greater concentrations of mercury because of their position in the food chain.

The issue of mercury at the La Grande complex was the subject of a trilateral agreement, called the *C.Q. — H.-Q. Mercury Agreement (1986)*, signed by the Québec government, the Cree Regional Authority and Hydro-Québec. The cost of the agreement is $18 million, of which $12.4 million is provided by Hydro-Québec, and its term is 10 years (1986-1995). By 1986, medical follow-up and information campaigns undertaken by the Cree Board of Health and Social Services had brought the level of mercury in the Chisasibi Cree down to levels comparable to those recorded before the reservoirs were created.

Experience acquired at the La Grande complex has made it possible to develop solutions for the Grande Baleine project. A comprehensive approach will be taken in collaboration with native communities, as was done under the above-mentioned Agreement. Thus a food supply based on resources other than predatory fish could be envisaged.

**Figure 4.1**
La Grande 2 Reservoir
Average Mercury Concentration in the Flesh of Lake Whitefish and Northern Pike




### *4.2.4 Environmental Research*

Environmental research is important in the development of the knowledge required to pursue the study of cumulative environmental effects, preliminary studies and impact-assessment studies. Much of the research also attempts to solve operating problems, and research results are integrated into the planning and design of installations.

Environmental research seeks practical and effective ways to mitigate the negative impacts of projects, enhance Québec's resources and improve the environmental performance of facilities. It consists of three main programs:

- wildlife resources and habitats;
- land-use development and regional development;
- environmental health.

Each program consists of three types of activity:

- acquisition of knowledge;
- development of analytical tools and protection and enhancement technologies;
- environmental follow-up.

## *4.3 Hydro-Québec's Environmental Performance*

Québecers have made environmental protection their foremost concern. In fact, the utility's environmental performance is as important to its customers as is its quality of service. Hydro-Québec will therefore ensure that its environmental performance attains or maintains the level that the public demands. It will, as of 1990, be gradually introducing specific programs to evaluate and audit its performance level.

In addition, Hydro-Québec has concluded that public awareness of its environmental activities and obligations is quite limited. It is thus in the utility's interest to publicize the results of its environmental studies and activities as well as its environmental orientations, as much as possible.

| Objective | Strategies |
|---|---|
| Evaluate Hydro-Québec's environmental performance | Evaluate performance using appropriate indicators<br>Evaluate total environmental spending requirements<br>Develop environmental-audit mechanisms |

**Table 4.3**
Environmental Issues Related to the Installations Plan

| **Project** (stage of realization) | **Environmental Issues** | **Solutions Put Forward or Already Implemented*** |
|---|---|---|
| **Grande Baleine** (phase 2 of draft design) | Native peoples' way of life | Encourage native communities' social and economic development, according to needs, that would allow them to continue traditional activities |
| | Mercury | Work together with native peoples: find temporary solutions for an alternative food supply |
| | Natural environment:<br>– sea mammals (changes in the freshwater supply in the Strait of Manitounouk)<br>– freshwater seals (changes in the flow of certain rivers feeding Lac aux Loups Marins)<br>– migratory birds (reduced habitats) | Environmental and impact-assessment studies in progress<br>Studies of freshwater seals to determine whether they are in fact an endemic species |
| **Sainte-Marguerite** (phase 2 of draft design) | Traditional Montagnais activities (fishing, hunting and trapping) | Multifunctional approach to the project in collaboration with native peoples and other land users |
| | Recreational and tourist activities<br>Salmon in the Moisie River (effect of diverting the Carheil and aux Pékans rivers into the Moisie River) | Stabilization of flow conditions to preserve and even improve salmon habitats, and to encourage sport fishing |
| | | Ongoing scientific committee, comprised of representatives of Hydro-Québec, the Atlantic Salmon Federation, Fisheries and Oceans Canada, the Québec *ministère du Loisir, de la Chasse et de la Pêche*, environmental consulting firms, and the Atikamek-Montagnais Band Council |
| | Merchantable timber | Project schedule altered to allow the recovery of merchantable timber and processing by local mills |
| | | Bring forward construction of the access road, which would eventually have been built by the local forestry industry |
| | Direct and indirect socio-economic spinoffs | Consultation with population and other users:<br>– maximize spinoffs so as to contribute to regional development<br>– plan the road to provide access to the regions' other forest resources; develop recreational and tourist infrastructures; and carry out measures to protect and enhance wildlife habitats |
| **Ashuapmushuan** (phase 1 of draft design) | Landlocked salmon | Original project (4 stations, 1,150 megawatts) reduced to 2 stations with a total of 730 megawatts at peak |
| | Heritage and recreational value of the river<br>Regional and economic spinoffs<br>Traditional Montagnais activities (hunting and trapping) | Multifunctional approach to harmonize, through dialogue and the introduction of appropriate measures, the various uses of the river and the flooded zones, and to enhance local and regional socio-economic spinoffs |
| | | Creation, in 1989, of the *Centre écologique du Lac Saint-Jean* with financial assistance from Hydro-Québec |

* All projects receive a rigorous impact study and appropriate mitigative measures.

| Project (stage of realization) | Environmental Issues | Solutions Put Forward or Already Implemented* |
|---|---|---|
| **Nottaway-Broadback-Rupert** (phase 1 of draft design begins in 1990) | Mercury<br>Wildlife (moose and wildfowl)<br>Estuarine habitats<br>Native peoples' ways of life (possible cumulative effects with the La Grande and Grande Baleine complexes)<br>Opening-up of the territory with the access roads | Construction of the project in several stages, from 2001 through 2026, rather than in a single block of 8,400 megawatts. Staggered construction will permit better management of land clearing, and reduce the project's main impacts on local ways of life.<br>Work together with native peoples (find temporary solutions for an alternative food supply) |
| **Gas-turbine stations: La Citière (addition of 500 megawatts) and Bécancour (300 megawatts)** (end of draft-design studies) | Atmospheric pollution by emissions of nitrogen oxides ($NO_x$) and sulphuric oxide ($SO_2$)<br>Noise<br>Future use of surrounding land | Studies on La Citière show that air-quality standards will be maintained. Studies on Bécancour are still in progress.<br>Design and implement appropriate mitigative measures to respect provincial and municipal noise regulations |
| **Haut-Saint-Maurice (Rapides des Coeurs, de la Chaudière et Manigance)** (phase 1 of draft design) | Flooding of approximately 10% of the Atikamek reserve, Weymontachie<br>Flooding of productive forest areas and recovery of merchantable timber<br>Mercury<br>Rerouting of a section of track owned by Canadian National Railways | Impact-assessment study in progress<br>Consult with other land users in the region |
| **Transmission lines (12th and 13th lines are required in the short term)** (phase 1 of draft design) | Land-use organization and structure in the inhabited areas at the foot of the Laurentians and in the St. Lawrence Valley:<br>– recreational areas north of Montréal (Gatineau, Outaouais and Lower Laurentians)<br>– preservation of natural landscapes<br>– crossing of major rivers (St. Lawrence, Saguenay and Ottawa)<br>– visual integration of facilities | Impact-assessment studies in progress<br>Location, design and implementation of appropriate mitigative measures in collaboration with communities affected and with land-use planners and developers of the various areas crossed, especially regional county municipalities (RCMs) |

* All projects receive a rigorous impact study and appropriate mitigative measures.

# 5

# EMPLOYEE MOBILIZATION

In its previous Development Plan, Hydro-Québec identified employee mobilization as a strategic concern for the 1990s. Today, this concern has become even more pressing, given the urgent and major challenges that lie ahead: modernization that focuses on power-system reliability and quality of service; balancing the development of installations, changing markets, and concerns relating to the physical and social environment; and maintaining the financial soundness for which Hydro-Québec has always been known.

To meet the new challenges of the 1990s, the utility requires optimal involvement from all its work force. Employees, management and unions must together define those conditions that will enable the utility to achieve its major objectives. There is no doubt that the difficulties, criticism and disputes that have plagued it in recent years have affected the climate of work and employees' commitment. At this stage of its development, it is imperative that Hydro-Québec rally and mobilize the strengths of its employees.

Three areas take priority. The first is to continue the mobilization measures begun last year to involve managers and specialists in a more comprehensive, longer-term strategic development plan pertaining to all human resources. The second concerns relations with unionized employees, with whom the utility must in the shorter term negotiate and implement agreements that will constitute a new consensus focusing on service quality, productivity and employee aspirations. The third relates to training replacement personnel and to moderate growth in the utility's staff levels: at the dawn of this new decade, Hydro-Québec must strengthen its internal and external recruiting efforts, and ensure that the technical, commercial and management expertise of all employees remains at the forefront of progress.

Mobilization, improved labor relations with unionized employees, and staffing and training are the three human resources management objectives that will enable the utility to meet the challenges identified in this Development Plan.

| Objectives | Strategies |
|---|---|
| Promote employee mobilization throughout the utility | Continue the *Action-cadres* program (redefining and enriching the management role)<br>Implement the new *Régime de gestion des spécialistes* (specialists' management plan)<br>Improve occupational health and safety management<br>Implement an employee-mobilization plan for the 1990s |
| Negotiate and implement new collective agreements with a view to improving the working climate | Renew collective agreements with CUPE and the *Fraternité des constables spéciaux d'Hydro-Québec*, and sign a first collective agreement with the *Syndicat professionnel des scientifiques de l'IREQ* (SPS!)<br>Implement the information, training and follow-up measures associated with the new collective agreements, with a view to improving the working climate |
| Reinforce staffing and intensify training to support the utility's objective of enhanced service quality and productivity | Reinforce the staffing function<br>Increase women's representation<br>Develop long-term human resources management<br>Intensify training and professional development |

## *5.1 Mobilization of Employees Throughout the Utility*

In 1989, measures were introduced to mobilize various groups of employees and enhance productivity and improve the working climate. These short- and medium-term measures primarily affected the managers and specialists, and also focused on occupational health and safety management. In the longer term, an employee-mobilization plan will be developed and implemented as of 1990, serving as a frame of reference for adapting human resources management to the challenges of the 1990s.

### Continue the Action-cadres program (redefining and enriching the management role)

Managers were affected significantly by the changes that took place at Hydro-Québec in the 1980s. Thus *Action-cadres*, a three-year program, was launched late in 1988 to redefine and enrich the role of, and provide support for, the utility's 2,200 managers.

A number of the 20 proposed measures were introduced in 1989, as planned. The most noteworthy are: creation of an ongoing consultation structure to increase management involvement in collective bargaining; steps taken to deepen understanding of the financial statements and budget processes; initial reorganization of the work of supervisory management to enable them to spend more time in the field with their crews; and development of a training program for new managers.

In 1990, the focus will be on improving internal communications. A number of measures will also be taken regarding continuing education, professional career tracks and management succession. A collective bonus program will be introduced during the year to recognize team performance, and a review of job-evaluation procedures for managers will begin.

**Implement the new *Régime de gestion des spécialistes* (specialists' management plan)**

This new plan is based on the same philosophy as the *Action-cadres* program and began at the same time, late in 1988. Specialists have responsibilities directly complementary to those of management. The new program's purpose is to redefine their role in relation to that of management, increase their mobility within Hydro-Québec and harmonize their salary scales, regardless of their field of activity. Phase I of the program, focusing on work organization, staffing and remuneration, began in 1989.

Phase I will continue in 1990, and phase II, regarding mobility and professional development, will get under way. Nevertheless, this program will have to take into account decisions by the Commissioner of Labor regarding applications to unionize certain specialists.

**Improve Occupational Health and Safety Management**

Hydro-Québec is aware of the impact that occupational accidents and hazards have on employees' quality of life and productivity, and is therefore concerned with improving the utility's health and safety performance. Since 1984, the utility has been progressively implementing the International Safety Rating System (ISRS).

Hydro-Québec had to revise its plan of action in 1989, however, when the rating agency raised its evaluation criteria.

Despite stricter requirements, the utility's objectives remain the same: to obtain a 3-star level by the end of 1991 and a 4-star level in 1993, which will now be much more difficult to attain because of the more demanding criteria. Areas of note for 1990 in the revised plan of action are: measures that will be implemented to increase senior management's involvement when serious accidents occur, and improving the functioning of joint (labor-management) committees on health and safety.

With respect to occupational health, more than 4,000 employees received general training in 1989, and training required under the Workplace Hazardous Materials Information System (WHMIS) will be provided in 1990 especially for those employees most exposed to hazardous chemicals.

Health and safety management will also be improved by changes in power-system components and upgraded equipment and working tools. The Distribution function alone spent $24 million on these changes in 1989 and expects to spend an average of $50 million a year from 1990 to 1995.

In the field of ergonomics, a study has examined the work procedures of distribution lineworkers, and the results will determine how improvements in the work environment and working methods can be gradually introduced so as to reduce the incidence of back problems.

Several studies are also in progress on the biological effects of electric and magnetic fields. Hydro-Québec is in fact involved in a wide-ranging epidemiological study of electrical utility employees that examines 150,000 medical files of workers at Hydro-Québec, Électricité de France and Ontario Hydro. This study began in 1988 and should be completed by 1992.

**Implement a Strategic Employee-Mobilization Plan for the 1990s**

In 1989, although the focus was on immediate human resources priorities, a longer-term reorientation also began, including measures related to training the next generation and redefining and enriching managers' and specialists' roles. In 1990, Hydro-Québec will be developing an integrated plan to mobilize all employees, a major challenge for the utility in the 1990s.

Various studies on the work climate and employees' socio-cultural values have shown discrepancies between the values held by employees and management, problems related to motivation at work, and differences between management and employees in the importance they place on involvement.

The plan will thus establish specific approaches based on the values now held by the utility and on other values to be integrated into its corporate culture, such as developing a new solidarity, renewed leadership and individual accountability. In this context, and more than ever before, employees will be valued as the resource essential to Hydro-Québec's fulfilling its mandate.

To meet this mobilization challenge, a preliminary analysis was done in 1989 of human resources at Hydro-Québec. Senior management must now be consulted to determine the measures to be taken and their order of priority. On the basis of work done by a multidisciplinary task force created for this purpose, a strategic human resources plan will be carried out in 1990 through implementation of two main measures:

- involve managers in choosing major orientations – together identify work to complement the preliminary analysis, and preferred human resources development and management orientations;

- develop and implement a master plan to achieve the desired reorientation; this plan will specify the areas of activity and main programs to be carried out, including a major in-house communications program, as well as priority measures to be retained on the basis of their importance and immediate feasibility in 1990.

**Table 5.1**
Distribution of Permanent Employees
(at December 31, 1989)

| Job Group / Administrative Unit | Managers | Specialists | Engineers | Technicians | Clerical | Trades | Constables | TOTAL |
|---|---|---|---|---|---|---|---|---|
| **Region** | | | | | | | | |
| La Grande Rivière | 148 | 101 | 32 | 180 | 260 | 471 | – | 1,192 |
| Laurentides | 213 | 148 | 30 | 145 | 677 | 822 | – | 2,035 |
| Maisonneuve | 193 | 147 | 103 | 382 | 266 | 654 | – | 1,745 |
| Manicouagan | 108 | 61 | 26 | 154 | 162 | 434 | – | 945 |
| Matapédia | 67 | 60 | 10 | 67 | 194 | 245 | – | 643 |
| Mauricie | 219 | 138 | 112 | 251 | 426 | 777 | – | 1,923 |
| Montmorency | 205 | 140 | 42 | 209 | 585 | 702 | – | 1,883 |
| Richelieu | 192 | 123 | 34 | 154 | 580 | 667 | – | 1,750 |
| Saguenay | 65 | 41 | 11 | 74 | 127 | 203 | – | 521 |
| Saint-Laurent | 203 | 188 | 38 | 64 | 847 | 649 | – | 1,989 |
| **Total** | 1,613 | 1,147 | 438 | 1,680 | 4,124 | 5,824 | – | 14,626 |
| Men | 1,551 | 929 | 420 | 1,658 | 1,990 | 5,588 | – | 12,136 |
| Women | 62 | 218 | 18 | 22 | 2,134 | 36 | – | 2,490 |
| **Installations Group** | 213 | 344 | 316 | 147 | 360 | 12 | – | 1,392 |
| Men | 201 | 271 | 300 | 144 | 131 | 10 | – | 1,057 |
| Women | 12 | 73 | 16 | 3 | 229 | 2 | – | 335 |
| **Head Office** | 394 | 1,302 | 450 | 258 | 727 | 180 | 108 | 3,419 |
| Men | 356 | 920 | 424 | 253 | 165 | 172 | 101 | 2,391 |
| Women | 38 | 382 | 26 | 5 | 562 | 8 | 7 | 1,028 |
| **Total Hydro-Québec** | 2,220 | 2,793 | 1,204 | 2,085 | 5,211 | 5,816 | 108 | 19,437 |
| Men | 2,108 | 2,120 | 1,144 | 2,055 | 2,286 | 5,770 | 101 | 15,584 |
| Women | 112 | 673 | 60 | 30 | 2,925 | 46 | 7 | 3,853 |

## *5.2 Negotiation and Implemention of New Collective Agreements with a View to Improving the Working Climate*

Given a unionization rate of more than 75% for operating personnel (permanent and temporary), labor relations is an important aspect of the utility's management activities. Thus renewal and implementation of collective agreements affecting more than 17,500 people was one of the main human resources objectives in 1989. As this objective has not yet been reached, the negotiation and implementation of new agreements, with a view to internal coherence, remains a corporate objective for 1990-1992. This will be achieved through improved labor relations and cooperation with unionized employees and their representatives.

It was possible to conclude a number of agreements in 1989 to the satisfaction of both parties. Hydro-Québec renewed its agreements with temporary construction personnel, except those working for Preliminary Studies. A new agreement with the *Syndicat professionnel des ingénieurs d'Hydro-Québec* (SPIHQ) settled disputes regarding accreditation and salary scales. Lastly, the first collective agreement with the *Syndicat professionnel des scientifiques de l'IREQ* (SPSI), accredited in 1989, will have to be ratified by the scientists in 1990. Nonetheless, an agreement covering salary revision for the current year was reached late in 1989.

An improved climate of work is an important concern in the short and medium term. The lengthy and difficult labor dispute that occurred in 1989 was characterized by management's firm determination to institute recovery measures, which encountered some obstacles. The utility must now take steps to effect a rapprochement between managers (especially supervisory managers) and employees, and between unions and management.

The strategy for implementing new agreements and a number of *Action-cadres* activities do aim to improve labor relations. But, first and foremost, measures must be taken to promote communications and direct relations between supervisory management and their employees to re-establish mutual trust. Employees and unions must be kept informed of and involved in the search for solutions, supervisory management must be more present on the work site, regular meetings between employees and their superiors must be held, and so on.

The main issues are contracting-out, notably maintaining and clarifying the balance between work done internally and externally, as well as management of temporary employees, rules governing the right to refuse work for safety reasons and the creation of shifts – three matters relating to productivity. The new agreements should also set out Hydro-Québec's commitments regarding training, mainly for Technicians and Trades employees, and ensure that wages and benefits remain comparable to those at other large Québec companies.

The strategies regarding collective agreements are as follows:

- renew agreements with locals affiliated with the Canadian Union of Public Employees (CUPE) and with the *Fraternité des constables spéciaux d'Hydro-Québec*, and sign a first collective agreement with the *Syndicat professionnel des scientifiques de l'IREQ* (SPSI);

- implement the information, training and follow-up measures associated with the new collective agreements for an improved working climate.

**Table 5.2**
Employees by Union Accreditation
(at December 31, 1989)

| | Permanent | Temporary |
|---|---|---|
| **Operations** | | |
| Syndicat Professionnel des Ingénieurs de l'Hydro-Québec | 1,181 | 36 |
| Syndicat Professionnel des Scientifiques de l'IREQ | 172 | 1 |
| Syndicat des technicien-ne-s d'Hydro-Québec | 2,079 | 265 |
| Syndicat des employé-e-s de bureau d'Hydro-Québec | 4,969 | 1,770 |
| Syndicat des employé-e-s de bureau d'Hydro-Québec (annexe) | 34 | 134 |
| Syndicat des employés de métiers d'Hydro-Québec | 5,693 | 754 |
| Syndicat des employés de métiers d'Hydro-Québec – Répartiteurs | 118 | – |
| Fraternité des constables spéciaux d'Hydro-Québec | 108 | 206 |
| **Subtotal** | 14,354 | 3,166 |
| **Construction** | | |
| Governed by agreements with Hydro-Québec | – | 120 |
| Construction Decree | – | 78 |
| **Subtotal** | – | 198 |
| **Total** | 14,354 | 3,364 |

## *5.3 Reinforced Staffing and Intensified Training To Support the Corporate Objective of Enhanced Service Quality and Productivity*

### Reinforce Staffing

To serve its customers, Hydro-Québec has almost 19,500 permanent employees and more than 5,000 temporary employees working in 10 administrative regions, at head office and in the Installations Group. The number of employees, which is already substantial, will increase between now and 1992 by 3.3% a year for permanent employees so as to meet the requirements of the various client oriented service quality enhancement programs, power-system reliability and normal growth in activities.

This influx of new blood, which in 1989 represented nearly 600 hirings and in 1990-1992 will represent more than 3,300, is a departure from the downsizing and relative stability of the 1980s, as seen in table 5.4. The period of moderate growth now under way will enable young people to obtain employment at Hydro-Québec and will promote more rapid integration of women. For permanent employees, it will create opportunities for promotion, lateral mobility and reorientation. For example, in 1989 more than 500 employees changed from one job group to another. Moreover, if changes from one unit or position to another are included, about 25% of all permanent employees will be reassigned each year within the utility.

As recruiting and internal mobility increase in importance, staffing must be adapted and strengthened. In 1989, management expressed certain misgivings about the length of the recruiting process. This process must become more rapid and rigorous, while taking into account equal-opportunity requirements for target groups. Temporary employees must also be selected with greater care, because they generally take priority over outside applicants when permanent positions are filled.

The following staffing strategy will be implemented:

- develop and adopt a staffing policy that covers turnover (hirings and departures) of permanent and temporary employees and internal mobility (promotions, lateral moves, etc.);
- develop directives applicable to specific groups, in particular for external and internal recruiting of managers, specialists and non-unionized employees;
- revise the hiring process for unionized employees, including the preselection procedure, medical examinations prior to hiring, evaluation of applicants' abilities and personality profile, and training of employees responsible for recruiting unionized personnel.

**Table 5.3**
Mobility and Turnover of Permanent Employees in 1989*

| Job Group | Employees at Dec 31 1988 | % | Hirings 1989** | Departures 1989 | Arrivals in the group | Departures from the group | Employees at Dec. 31 1989 | % |
|---|---|---|---|---|---|---|---|---|
| Managers | 2,149 | 11.2 | 11 | 75 | 222 | 87 | 2,220 | 11.4 |
| Specialists | 2,697 | 14.0 | 106 | 76 | 183 | 117 | 2,793 | 14.4 |
| Engineers | 1,165 | 6.0 | 68 | 20 | 28 | 37 | 1,204 | 6.2 |
| Technicians | 2,009 | 10.4 | 74 | 25 | 67 | 40 | 2,085 | 10.7 |
| Clerical | 5,270 | 27.4 | 127 | 84 | 17 | 119 | 5,211 | 26.8 |
| Trades | 5,848 | 30.4 | 207 | 126 | 20 | 133 | 5,816 | 29.9 |
| Constables | 114 | 0.6 | 1 | 3 | 0 | 4 | 108 | 0.6 |
| **Total** | 19,252 | 100.0 | 594 | 409 | 537 | 537 | 19,437 | 100.0 |

* Excludes subsidiaries.
** Includes net movements to or from subsidiaries.

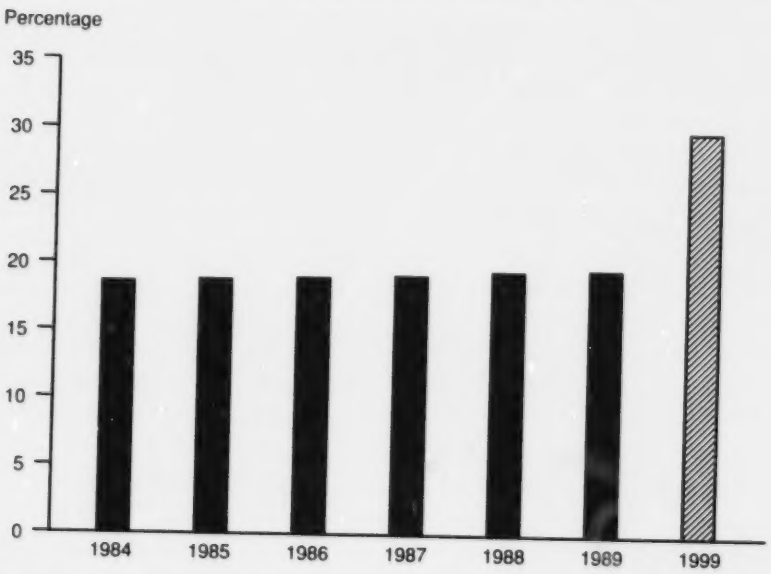
## Increase Women's Representation

The strategy to reinforce staffing will be complemented by a specific strategy to increase the proportion of women working for the utility.

Despite the efforts of the past 10 years, women are still under-represented at Hydro-Québec. From 1984 to 1989, the proportion of women increased by only 1.2 %, and now stands at about 20 % of permanent employees. To accelerate this trend, an Equal Opportunity Program that complies with the regulations of the Québec Human Rights Commission is being developed. Moreover, without neglecting the other target groups, in 1989 the utility adopted the 10-year objective of increasing the proportion of women to 30 % of permanent employees by 1999. This corporate commitment was announced officially at a conference of women managers, specialists and engineers in October 1989.

To reach the 30 % level, additional efforts must be made. Firm measures regarding the hiring and promotion of women will be initiated in 1990 by the various units in which women are under-represented, and a follow-up procedure will be implemented during the year. At the same time, an analysis of the employment system (staffing, remuneration, training and working conditions) will identify the systemic obstacles that women encounter at Hydro-Québec. This analysis will become the basis for qualitative enhancement objectives.

**Figure 5.1**
Permanent Women Employees at Hydro-Québec and 1999 Objective



**Develop Long-Term Management of Human Resources**

Given that staffing activities will assume greater importance in the years to come, it is essential that staff planning be better defined. The first component of this effort is studies and analyses of employment categories (permanent, temporary and contracting-out) as a function of Hydro-Québec's present and future work load. It is also necessary to develop performance and productivity guidelines for long-term management.

During the 1990-1992 period, these studies and tools will be developed to form the basis for further staff planning and enhanced management control. The three aims will be to:

- harmonize the human resources' forecasting process among the utility's units or functions;
- pursue studies on turnover, mobility and temporary employees;
- establish performance guidelines in human resources, primarily as regards staffing, remuneration and benefits, with a view to measuring utility-wide productivity.

**Intensify Training and Professional Development**

Rapidly filling positions with qualified applicants will contribute significantly to greater productivity, but it is equally important to maintain a high level of on-the-job performance. The stability of Hydro-Québec's staff, the highly technical nature of jobs and rapid technological change have created the need for intensified continuing education and professional development. These measures, tailored to the various job categories, are intended to enhance the quality of individual work, customer service and employee satisfaction.

For example, in 1989 the *groupe Exploitation régionale* (Regional Operations), which covers the employees working in the utility's 10 administrative regions, set aside over $25 million for personnel training throughout the utility. This figure is tangible proof that the development of employees, in their current positions or in their career tracks, is fundamental to the utility's human resources management philosophy.

Several new programs were launched in 1988 and 1989. Unionized clerical employees now receive specific training when they change jobs and may advance to more complex positions by obtaining preparatory training offered at the CEGEP (community college) level. An information system summarizing engineers' existing qualifications was implemented in 1989 and will facilitate the development of programs and approaches for this group. With respect to managers and specialists, the *Action-cadres* program and the new specialists' management plan contain concrete professional-development measures for 1990 and subsequent years. As well, environmental awareness training for operations employees will continue in 1990-1992.

Basically, however, human resources' efforts will focus mainly on technical and marketing training related to the utility's primary mandate. The technical training plans for trades and technical employees, which are central to collective bargaining, are one of the utility's priorities, because they will determine the success of power-system reliability and service-quality efforts. These training plans will cover generation, transmission, sub-transmission, distribution and telecommunications, as well as marketing activities that deal directly with customers.

The utility has, therefore, made a commitment to develop an integrated human resources development policy in 1990, based on professional development relating to current positions and career tracks within the utility. It will continue or will implement diversified programs according to job groups, taking into account the utility's needs and employees' aspirations.

**Table 5.4**
Employee Statistics

| | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Permanent Employees*** (at December 31) | 18,975 | 18,560 | 18,208 | 18,470 | 18,933 | 19,252 | 19,437 | 20,200 | 20,900 | 21,400 |
| Employees at January 1 | 19,959 | 18,975 | 18,560 | 18,208 | 18,470 | 18,933 | 19,252 | 19,437 | 20,200 | 20,900 |
| Hirings for the year** | 146 | 217 | 595 | 487 | 685 | 712 | 594 | 1,188 | 1,150 | 975 |
| Departures for the year | | | | | | | | | | |
| - retirements | 871 | 501 | 803 | 114 | 132 | 237 | 292 | 300 | 315 | 330 |
| - other | 259 | 131 | 144 | 111 | 90 | 156 | 117 | 125 | 135 | 145 |
| **Temporary Employees***** | 1,986 | 2,186 | 3,163 | 2,749 | 2,989 | 3,521 | 4,425 | 5,174 | 4,805 | 4,505 |
| Operations | 1,610 | 1,886 | 2,788 | 2,326 | 2,656 | 3,108 | 3,885 | 4,669 | 4,300 | 4,000 |
| Construction | 262 | 186 | 195 | 242 | 204 | 250 | 328 | 375 | 375 | 375 |
| Construction Decree | 114 | 114 | 180 | 181 | 129 | 163 | 212 | 130 | 130 | 130 |
| **Management Employees – SEBJ** (in person-years) | 982 | 485 | 200 | 121 | 153 | 200 | 390 | 625 | 675 | 675 |

* Excludes subsidiaries.
** Includes net movements to or from subsidiaries.
*** Average based on 26 pay periods.

# 6

# FINANCE AND RATES

Hydro-Québec's financial performance since 1982 illustrates its vulnerability to the various risks and cyclical fluctuations in its environment. Thus, from 1982 to 1987, Hydro-Québec focused on eliminating the imbalance between supply and demand resulting from the recession at the start of the decade, and on introducing recovery measures to maintain control over costs. When combined with vigorous economic growth and the substantial rise in the value of the Canadian dollar, these activities resulted in improvement in the principal financial ratios from 1986 to 1988.

In the last two years, low runoff has been the prime factor affecting financial results, causing a reduction in net income of more than $500 million cumulatively. This is occurring at a time when Hydro-Québec is beginning to resume investment to satisfy growing need for electricity in Québec and to improve the quality of service and reliability of the system, both of which will put upward pressure on the utility's costs of supply. In this context, rate increases equal to inflation, as proposed in last year's Development Plan, are inadequate to check a significant worsening in the utility's principal financial ratios.

In order to support the substantial borrowing forecast for the next decade, it is fundamental that Hydro-Québec avoid any additional deterioration in its financial situation and restore a margin of manoeuvre that will make it possible to cope with various risk factors. To this end, the utility will continue efforts to improve productivity in order to control costs. It will require rate increases in the next few years that will enable it to achieve by 1992 most of the financial ratios needed for continued development. Such rate increases, which reflect the rates policy that aims to cover costs of supply, will also promote the success of energy conservation programs.

**Table 6.1**
Evolution of Financial Performance

| | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|---|---|
| Net earnings (in millions of dollars) | 800 | 707 | 301 | 209 | 303 | 508 | 619 | 565 |
| Interest coverage | 1.01 | 1.04 | 1.10 | 1.12 | 1.15 | 1.25 | 1.26 | 1.12 |
| Capitalization (in %) | 26.0 | 26.6 | 25.3 | 24.1 | 24.0 | 24.9 | 26.2 | 25.9 |
| Return on equity (in %) | 15.0 | 11.7 | 4.7 | 3.2 | 4.4 | 7.0 | 8.0 | 7.0 |
| Average cost of debt (in %) | 11.8 | 11.5 | 11.7 | 11.4 | 11.1 | 10.7 | 10.5 | 11.2 |
| Self-financing (in %) | 35.1 | 40.3 | 34.2 | 35.7 | 40.6 | 41.0 | 34.0 | 30.0 |
| Profit margin (in %) | 24.1 | 19.3 | 7.2 | 4.7 | 6.4 | 10.0 | 11.7 | 10.2 |

## *6.1 Financial Impact of Runoff*

The improvement in the utility's financial health has been slowed by the measures implemented since 1987 to cope with low runoff. In 1988, sales of surplus energy on both export and Québec markets were less than had been forecast in the 1988-90 Development Plan.

In 1989, there was a further reduction against forecasts which had already been substantially lowered in the 1989-1991 Development Plan.

In 1989, the utility had to use exceptional measures to deal with the shortage of water in its reservoirs: operation of Tracy thermal generating station as a base-load facility, purchases from neighboring systems and buyback of dual-energy contracts from commercial, institutional and industrial customers.

**Table 6.2**
Financial Impact of Low Runoff in 1988 and 1989
(in millions of dollars)

| | 1988 | | 1989 | |
|---|---|---|---|---|
| | TWh | $ | TWh | $ |
| Reduction in surplus sales (Quebec and external markets) | | | | |
| – Revenue shortfall | 9.6 | 211 | 2.6 | 48* |
| – Buyback of boiler contracts | – | 19 | – | – |
| Buyback of dual-energy | | | | |
| – Revenue shortfall | – | – | 0.3 | 5 |
| – Compensation | – | – | – | 76 |
| Purchase of support | 0.7 | 14 | 3.5 | 104 |
| Operation of Tracy as a base-load installation | – | – | 1.2 | 34 |
| Total | 10.3 | 244 | 7.6 | 267 |

* These reductions are added to the 13.2 terawatthours and $306 million already projected for 1989 in the 1989-1991 Development Plan

During the low runoff cycle which began in 1984, Hydro-Québec experienced four particularly dry years. This situation forces the utility to extend the use of exceptional measures into 1990, even in the average runoff scenario. Reservoirs must be refilled to ensure a more acceptable level of energy reliability for the future, with additional expenditures and revenue losses of more than $300 million in 1990. However, the utility will have to re-evaluate the situation in 1990, to adjust its strategy to runoff levels actually experienced during the first months of the year.

The corporation's financial situation remains largely dependent on runoff fluctuations, as Table 6.3 illustrates. Thus, if low runoff persists in the next three years, with 15% lower inflows than the annual average, creating an energy shortfall of 75 terawatthours, the utility would have to support additional costs starting in 1990 that could attain as much as $850 million in 1992. On the other hand, in a scenario of heavy runoff, with a 75-terawatthour surplus, the utility would cease to make use of the exceptional measures during 1990. Once the reservoirs are full, surplus-energy sales could be envisaged in 1991, and certainly in 1992. Hydro-Québec's net income could increase by some $550 million in 1992. 1992 net income could thus vary by as much as $1.4 billion, depending on runoff levels.

**Table 6.3**
Financial Impact of Various Runoff Scenarios *
(in millions of dollars)

| | 1990 | | 1991 | | 1992 | |
|---|---|---|---|---|---|---|
| | TWh | $ | TWh | $ | TWh | $ |
| **Low runoff** | 13.6 | 583 | 15.3 | 758 | 15.2 | 853 |
| **Average runoff** | | | | | | |
| Buyback of dual-energy | | | | | | |
| – Revenue shortfall | 3.8 | 102 | – | – | – | – |
| – Compensation | – | 9 | – | – | – | – |
| Purchases of support | 3.5 | 122 | – | – | – | – |
| Tracy operated as a base-load installation | 2.6 | 81 | – | – | – | – |
| **Total** | 9.9 | 314 | – | – | – | – |
| **Heavy runoff** ** | 8.9 | 282 | (8.0) | (221) | (19.0) | (553) |

* The totals represent all exceptional measures used for each scenario in terawatthours and the corresponding financial impact
** The figures in parentheses are sales of surplus energy and the associated revenue

## *6.2 Evolution of Expenditure and Improved Productivity*

Hydro-Québec has taken major steps since 1982 to hold down costs. Growth in operating expenditure adjusted for inflation was reduced to 1.9% on average per year from 1982 to 1988, compared to an average of 10% for the period from 1976 to 1982. Growth was held in check even though the utility experienced growth in total sales of 6% per year, 460,000 new customers were added and the transmission system increased by 3,200 kilometres and the distribution system by 4,300 kilometres.

The result was obtained from improved overall productivity resulting from rationalization of the utility's resources. Despite this, operating expenditure is up considerably for 1989 and 1990, primarily due to measures to counteract low runoff, the start-up of programs to enhance quality of service and energy conservation, and intensified training of employees. The substantial growth in other expenditure in 1989 and 1990 is primarily attributable to purchases of support needed to compensate for low runoff levels.

**Table 6.4**
Operating Expenditure
(in millions of dollars)

| | 1988 | 1989 | | 1990 | | 1991 | | 1992 | |
|---|---|---|---|---|---|---|---|---|---|
| | $ | $ | % | $ | % | $ | % | $ | % |
| Operating expenditure | 1,391 | 1,597 | 14.8 | 1,788 | 12.0 | 1,902 | 6.4 | 2,062 | 8.4 |
| **Adjustment** | | | | | | | | | |
| Expenditure due to low runoff* | –19 | –110 | | –90 | | – | | – | |
| New programs | | | | | | | | | |
| – Quality of service | – | –7 | | –79 | | –108 | | –102 | |
| – Energy conservation | – | – | | –24 | | –49 | | –77 | |
| Training | –20 | –24 | | –44 | | –46 | | –49 | |
| Other ** | – | –9 | | –12 | | –47 | | –74 | |
| Adjusted operating expenditure | 1,352 | 1,447 | 7.0 | 1,539 | 6.4 | 1,652 | 7.3 | 1,760 | 6.6 |
| Increase in Canadian CPI (in %) | | | 4.9 | | 4.6 | | 5.7 | | 5.2 |
| Adjusted firm sales*** (in terawatthours) | 129.0 | 136.7 | 6.0 | 141.6 | 3.6 | 146.8 | 3.7 | 152.2 | 3.7 |

* Buyback of boiler contracts, operation of Tracy, and compensation for buyback of dual-energy contracts
** Application of Act 116, retirement expenditure, provision for decommissioning of Gentilly 2, and other current activities
*** Readjustments to include impact of buyback of dual-energy contracts

**Table 6.5**
Other Expenditure
(in millions of dollars)

| | 1988 | 1989 | | 1990 | | 1991 | | 1992 | |
|---|---|---|---|---|---|---|---|---|---|
| | $ | $ | % | $ | % | $ | % | $ | % |
| Purchase of energy and power | 136 | 253 | 86.0 | 253 | – | 182 | –28.1 | 223 | 22.5 |
| Depreciation of fixed assets | 538 | 585 | 8.7 | 635 | 8.5 | 687 | 8.2 | 744 | 8.3 |
| Taxes | 295 | 324 | 9.8 | 357 | 10.2 | 386 | 8.1 | 432 | 11.9 |
| Other expenditure | 969 | 1,162 | 19.9 | 1,245 | 7.1 | 1,255 | 0.8 | 1,399 | 11.5 |
| **Adjustment** | | | | | | | | | |
| Expenditure due to low runoff* | –14 | –104 | | –122 | | – | | – | |
| Purchases of power | –15 | –51 | | –27 | | –49 | | –55 | |
| Purchases from independent producers | – | – | | –1 | | –27 | | –78 | |
| Other adjusted expenditure | 940 | 1,007 | 7.1 | 1,095 | 8.7 | 1,179 | 7.7 | 1,266 | 7.4 |
| * Purchases of support | | | | | | | | | |

Hydro-Québec will hold down operating expenditure by continuing to improve individual productivity. A number of measures along these lines are already under way:

- inclusion in current collective bargaining of a number of productivity improvement issues related to quality of service. The five targeted areas are customer relations, revised work shifts, management of temporary employees, right of refusal (health and safety) and lunch breaks;
- clarification of the contracting-out clause, to restore a climate that will promote greater productivity while retaining the expertise of employees in regular system maintenance and operating activities;
- productivity improvement in carrying out transmission and distribution system work. One corporate objective will involve quantifiable measures to increase availability at the actual work site by 30% by 1992;
- implementation of the policy of preventive maintenance based on monitoring;
- technological improvements to tools to upgrade utility practices;
- intensification of company-wide training, to ensure the development of employee competence;
- management practices providing for greater accountability in individual administrative regions and corporate functional units with regard to results obtained in their specific mandates.

## 6.3 *Forecast Investment*

The next decade will see a marked increase in investments to satisfy growing demand for electricity in Québec, ensure the rehabilitation of installations and improve the energy and power reliability of generating facilities and the performance of the transmission and distribution systems.

In the 1990s, Hydro-Québec will invest $61.8 billion (in current dollars) or $45.8 billion in 1989 dollars including interest, in its construction program. More than half of this amount will go into expanding and maintaining generating facilities and a further 20% into the transmission system.

Total investment for the next three years will reach $13.2 billion, twice the amount invested over the last three years. Of this amount, $4 billion or more than 30% will be devoted to major generating and transmission projects already committed: La Grande 2A, La Grande 1, Brisay, Laforge 1 and the 11th and 12th transmission lines.

About $1 billion will be set aside for the construction of access roads at the Grande Baleine complex and the Sainte-Marguerite 1 project, as well as for the start of work on Eastmain 1. Included is the continuation of draft-design studies on those generating stations and the NBR and Ashuapmushuan complexes.

The target investment program also allocates over $1.6 billion over the next three years to ongoing efforts to improve quality of service.

**Table 6.6**
Investment for the Construction Program – Average Scenario
(in millions of dollars)

| Types of investment* | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 to 1999 | Total 1990-1999 | % |
|---|---|---|---|---|---|---|---|---|---|
| Generation | 340 | 499 | 795 | 1,545 | 2,435 | 2,699 | 26,263 | 32,942 | 53 |
| Transmission | 499 | 766 | 861 | 783 | 817 | 998 | 9,851 | 12,449 | 20 |
| Distribution | 518 | 494 | 494 | 703 | 764 | 848 | 7,758 | 10,073 | 17 |
| Support and technology | 224 | 274 | 262 | 357 | 452 | 439 | 3,834 | 5,082 | 8 |
| Grants, loans, investments and advances | 107 | 74 | 53 | 92 | 124 | 109 | 977 | 1,302 | 2 |
| **Total** | 1,688 | 2,107 | 2,465 | 3,480 | 4,592 | 5,093 | 48,683 | 61,848 | 100 |

* Investments in sub-distribution are included with transmission and distribution. For the historical data, they are entirely included with transmission

Forecast investment for the 1990-1998 period has been revised upward by $8.1 billion over those contained in last year's Development Plan. This upward revision is primarily due to the bringing-forward of commissioning of the first stations in the NBR complex to the start of the next century and the Eastmain 1 project from 2004 to 1996, the commissioning of peaking plant, the re-evaluation of the station rehabilitation program, increased spending on distribution (primarily the underground system) the maintenance – enhancement program (PAM) and the energy conservation programs.

Table 6.7 shows total investments in the strong and weak demand growth scenarios compared to the average growth scenario.

**Table 6.7**
Investment According to Various Scenarios
(in millions of dollars)

| Scenario | 1990 | 1991 | 1992 | 1993-1999 | 10-Year total |
|---|---|---|---|---|---|
| Low | 3,480 | 4,021 | 4,296 | 26,213 | 38,010 |
| Average | 3,480 | 4,592 | 5,093 | 48,683 | 61,848 |
| Heavy | 3,480 | 4,762 | 5,515 | 59,329 | 73,086 |

## 6.4 *Financial Policy*

| Objectives | Principal Strategies |
|---|---|
| **By 1992**<br>Improve the financial position of the utility in order to restore the desired margin of manoeuvre and support development while seeking to achieve its principal financial ratios:<br>• interest coverage of at least 1.0<br>• capitalization of at least 25%<br>• overall return on equity greater than the average cost of debt<br>• self-financing of at least 30% | Control cost increases and continue efforts to improve productivity<br>Minimize financing costs and manage financial risks<br>Limit the payment of dividends<br>Propose rate increases of 7.5% in 1990 and 7.5% in 1991, to better cover the costs of supply and support the energy conservation programs |
| **In the long term**<br>Recreate the margin of manoeuvre by improving the financial ratios to better reflect the risks faced by the utility | Continue to improve productivity, primarily through increased accountability of functional units<br>Develop new modes of financing and new instruments for managing financial risks<br>Optimize revenue by:<br>• rates structures that reflect the costs of supply, including an average return on equity of 13% on sales governed by the Rates Bylaw<br>• export market development aimed at a profitability level that is compatible with the specific risk involved |

### 6.4.1 *Risk Management*

The recent worsening in the utilities financial results demonstrates its vulnerability to external risk factors. Changes in demand, runoff, and exchange and interest rates can affect the desired improvements in the utilities financial situation. Hydro-Québec must manage its risks if it is to protect its customers, lenders and shareholder against an abrupt downturn in its financial situation. It is therefore working on risk management strategies and instruments.

The most serious risk that Hydro-Québec faces is the fluctuation in runoff levels, whose financial impact increases with the size and number of hydroelectric installations. For example, in the 1998 horizon, low runoff for four consecutive years would have a negative impact on net earnings of an average $800 million per year.

There is presently no financial instrument the utility can use to protect itself from low runoff. However, Hydro-Québec is studying the possibility of creating a runoff stabilization fund to reduce the fluctuations in financial results that runoff variation causes.

In coming years, growth of firm sales in Québec will come increasingly from industry. This trend makes the utility more vulnerable to economic fluctuations. Moreover, as part of the development of Québec markets, risk and profit sharing contracts with industrial customers that are major users of electricity can to some extent increase Hydro-Québec's business risk. Although the utility should recover the costs of supply over the life of these contracts, the concept of risk sharing on which this strategy is based may expose it to decreased revenue when the economic situation is unfavorable, so ways to minimize these risks should be found.

Thus, Hydro-Québec adopted a strategic financing plan in 1989 one of whose goals is to limit its vulnerability to interest and exchange rate fluctuations and included specific actions among its financial activities.

### *6.4.2 Establishing a Financial Margin of Manoeuvre*

Existing financial instruments and those it might develop cannot protect Hydro-Québec against all the risks in its economic and energy environment. It must therefore create a financial margin of manoeuvre that exceeds its minimal financial criteria of an interest coverage of 1.0 and capitalization of 25%.

Hydro-Québec had begun to reestablish its financial margin of manoeuvre in recent years. But measures to counteract low runoff have halted this progress and have reduced financial ratios to their minimum thresholds.

Without this margin, as the current situation demonstrates, any serious economic disruption could mean abrupt rate increases, or financial ratios that fall below minimum levels, which would be highly undesirable in a context of major hydroelectric development in Québec.

It is especially important for Hydro-Québec to create such a margin of manoeuvre because hydroelectricity is a capital-intensive product. Fixed costs take up a large share of expenditure and limit the utility's flexibility in financial management. For example, over the next three years, more than half the revenue from sales will be used to cover interest expense, exchange loss and depreciation of fixed assets.

Improvement of the financial situation and reconstitution of a minimum margin of manoeuvre require that Hydro-Québec try to meet the objectives of its financial policy by 1992:

- interest coverage of at least 1.0;
- capitalization of at least 25%;
- return on equity greater than the average cost of debt;
- self-financing ratio of at least 30%.

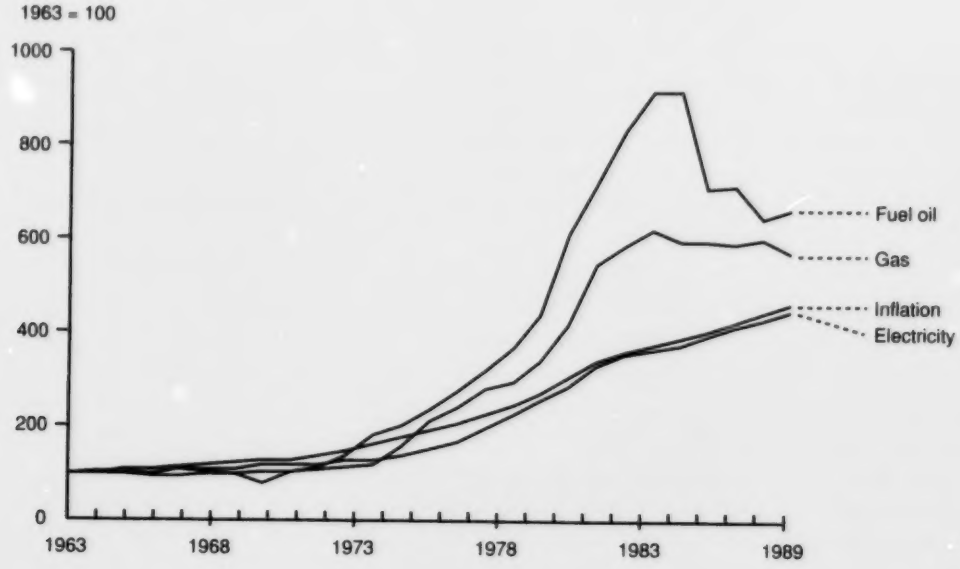
Hydro-Québec has in the past achieved a return on equity that exceeds the average cost of the debt and, if it achieved this again, it could re-establish its financial margin of manoeuvre. Two measures available to achieve this are cost-cutting and a rates policy that reflects the costs of supply including average return on equity of 13% for sales governed by the Rates Bylaw.

## *6.5 Costs of Supply and Rates*

### *6.5.1 Competitive Position*

Hydro-Québec has always been able to maintain competitive prices, in spite of a variable economic and energy context. As Figure 6.1 indicates, electricity prices have remained slightly below inflation. In real terms, consumers have actually been paying slightly less over time.

**Figure 6.1**
Inflation and Energy Prices



Hydro-Québec has been able to maintain a favorable competitive position in comparison with other forms of energy. In the fourth quarter of 1989, for example, electrical space and water heating for a single-family home cost 9% and 6% less than old fuel-oil and natural-gas systems, respectively. Such old systems make up the majority of fuel-oil and natural-gas heating systems in use in Québec.

Moreover, Québec consumers benefit from some of North America's lowest rates. For example, a residential customer in Vancouver pays 12% more than a Montrealer, and a Toronto resident pays 34% more. New York residents pay 216% more than their Montreal counterparts.

### *6.5.2 Cost Trends in the Short and Medium Term*

One goal of Hydro-Québec's rates structure has always been to reflect the average costs of supply. These consist of all operating expenditure as well as capital expenditure incurred to satisfy Québec demand, and in the case of new facilities, they increase only at the time of commissioning. Capital expenditure includes interest, exchange loss and the return on equity. Hydro-Québec aims for an average return on equity of 13% on sales subject to the Rates Bylaw. Such a return corresponds to the lower limit of average, after-tax return granted to utilities by their regulatory bodies.

This objective of reflecting the costs of supply in rates policy assumes even greater importance when customers are being encouraged to adopt consumption habits that are compatible with a better use of energy resources. The price signal to customers then becomes a major factor because energy conservation and good energy choices are difficult to make when the price signal is distorted and prices do not adequately reflect the costs of supply.

The rise in costs of supply over the three-year period covered by the 1990-1992 Development Plan is substantially greater than forecast in last year's Development Plan, for both contextual and structural reasons.

The contextual reasons include the low runoff which has lasted for six years, forcing the utility to implement a series of costly measures to provide adequate response to Québec demand. The effects of these measures will still be felt in 1990. As Table 6.8 indicates, intensive operation of Tracy generating station, the purchase of support power from neighboring systems and the additional expenditure associated with the buyback of dual-energy contracts will add some $212 million to 1990 expenditure.

Furthermore, structural modifications not factored into last year's Development Plan will result in major expenditure with no impact on sales. The increase has been estimated at $863 million for the 1990-1992 period, as Table 6.8 also indicates. These modifications primarily involve service quality enhancement, the upward revision of the power reliability criterion, the revision of average generating-station output, the acceleration of employee training and energy conservation programs.

**Table 6.8**
Impacts of Principal Modifications on Expenditure, Interest and Exchange Loss, Compared with the 1989-1991 Development Plan
(in millions of dollars)

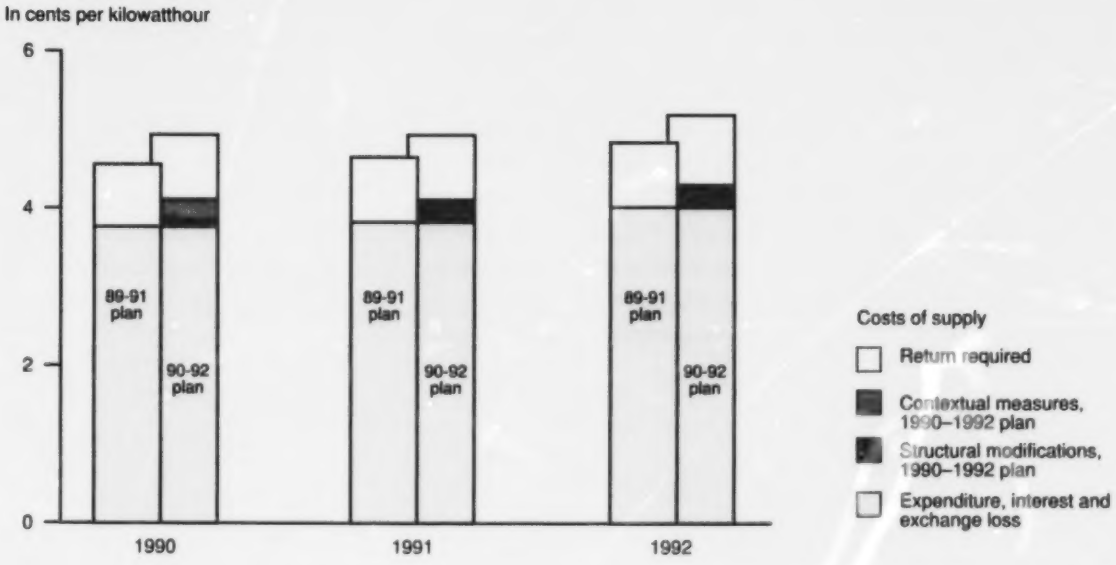
| | 1990 | 1991 | 1992 | Total |
|---|---|---|---|---|
| **Contextual impact** | | | | |
| Expenditure caused by low runoff* | 212 | 0 | 0 | 212 |
| **Structural impact** | | | | |
| Quality of service** | 83 | 118 | 123 | 324 |
| Power reliability and revision of the average output of generating stations*** | 0 | 58 | 150 | 208 |
| Energy conservation | 24 | 54 | 86 | 164 |
| Training programs | 16 | 20 | 20 | 56 |
| Other modifications**** | 7 | 53 | 51 | 111 |
| **Total structural impact** | 130 | 303 | 430 | 863 |
| **Total** | 342 | 303 | 430 | 1 075 |

* Excluding revenue shortfall of $102 million caused by the buy back of dual-energy contracts
** PAM and PAQS-Clientèle programs not evaluated in 1989-1991 Development Plan and reevaluation of PAQS-2 Program for the period
*** Involves additional generating equipment to cope with peak demand, power purchases, and purchases from independent producers
**** Renovation of generating stations, application of Act 116 concerning retirement, provision for decommissioning of Gentilly 2, modifications related to depreciation costs, taxes, economic parameters and other current activities

Thus, for the 1990-1992 period, the additional expenditure totals more than $1 billion. In 1992 the increase represents 7% of total expenditure, interest and exchange loss compared to last year's Development Plan.

Figure 6.2 illustrates the growth in costs of supply for the 1990-1992 period compared to last year's Development Plan, caused by contextual measures and structural modifications described earlier.

**FIGURE 6.2**




### *6.5.3 Rates Proposal*

**Table 6.9**
Past Rate Increases

| | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | Average |
|---|---|---|---|---|---|---|---|
| Electricity rates* (variation in %) | 3.4 | 2.5 | 5.4 | 4.6 | 3.9 | 4.3 | 4.0 |
| Canadian Consumer Price Index (variation in %) | 4.4 | 4.0 | 4.1 | 4.4 | 4.1 | 4.9 | 4.3 |

* At May 1 of each year except for 1984 – at February 1

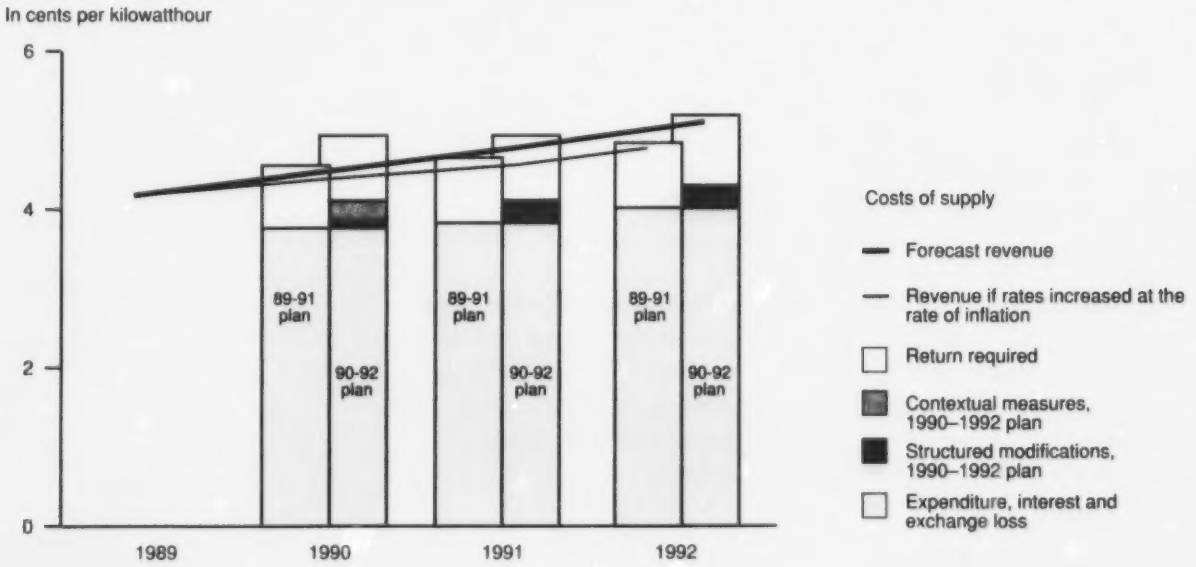
Over the last six years, Hydro-Québec's rates have remained slightly below inflation. In its 1989-1991 Development Plan, the utility envisaged rate increases on a par with inflation but, with the modifications now described, these rate increases would not cover its costs of supply and would diminish its financial soundness at a time of major increases in capital expenditure.

As customers must have a degree of rate stability, it appears quite unrealistic to attempt to achieve the costs of supply objective in 1990. The more than 20% rate increase required would constitute a real shock. Hydro-Québec proposes not to act in 1990 to make the necessary financial adjustment and therefore to allow certain financial ratios to fall to their lower limits. The approach will be gradual, with rate increases spread over time, so that growth of revenue will approach its goal in 1992. It is therefore important to give some guaranteed sign of recovery. That is why Hydro-Québec recommends an increase of 7.5% as of May 1, 1990, to be followed by an identical raise on May 1, 1991. Hydro-Québec retains the hypothesis of a 6% rate increase for 1992.

As Figure 6.3 indicates, with these proposed increases, Hydro-Québec would find itself by 1992 in a position comparable to that forecast last year. It should be noted that the difference in 1992 between revenue generated by increases that equal inflation, as advocated in the 1989-1991 Development Plan, and those generated by the present proposed increase are equivalent to the spending incurred for the modifications proposed and described above.

Further details appear in a separate publication entitled: *"Rates Proposal for 1990-1991"*.

**Figure 6.3**
Comparison of Revenue and Costs of Supply



### *6.5.4 Impact of Rate Increases on the Financial Ratios*

The results shown in Table 6.10 illustrate the impact of the proposed rate increases on the financial ratios by 1992. Rate increases equal to inflation, as set forth in the 1989-1991 Development Plan, would cause capitalization to fall below the minimum of 25%, and would barely cover interest. Self-financing would fall to 22.7% in 1992, the lowest ever posted by Hydro-Québec. Such a financial situation would affect the borrowing capacity of the utility, leaving it with no margin to cope with external factors. Even the proposed rate increases do not enable the utility to meet all the minimum financial ratios. With this in mind, the suggested increases are minimal.

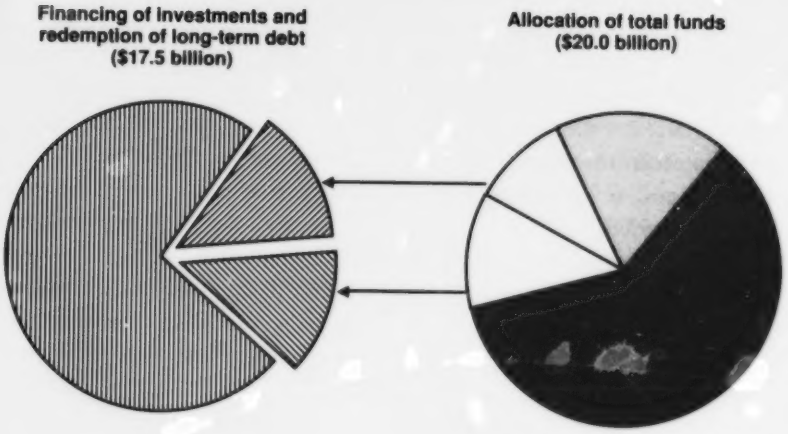
As shown in Figure 6.4, the proposed rate increases would allow the utility to obtain an average self-financing ratio of 28% for the 1990-1992 period.

**Table 6.10**
Impact of Rate Increases in the 1990-1992 Development Plan Compared with Increases Outlined in the 1989-1991 Development Plan

| | 1989 | 1990 | | 1991 | | 1992 | |
|---|---|---|---|---|---|---|---|
| | | Plan 1989-1991 | Plan 1990-1992 | Plan 1989-1991 | Plan 1990-1992 | Plan 1989-1991 | Plan 1990-1992 |
| **Proposed rate increases (in %)*** | | 4.5 | 7.5 | 4.3 | 7.5 | 5.2 | 6.0 |
| Net earnings (in millions of dollars) | 565 | 305 | 401 | 593 | 879 | 667 | 1 099 |
| Interest coverage | 1.12 | 1.02 | 1.05 | 1.08 | 1.17 | 1.08 | 1.19 |
| Capitalization (in %) | 25.9 | 24.4 | 24.7 | 23.6 | 24.5 | 22.6 | 24.4 |
| Return on equity (in %) | 7.0 | 3.6 | 4.8 | 6.7 | 9.7 | 7.1 | 10.9 |
| Self-financing (in %) | 30.0 | 23.7 | 25.8 | 22.8 | 27.5 | 22.7 | 29.0 |
| Profit margin (in %) | 10.2 | 5.2 | 6.8 | 9.2 | 13.1 | 9.5 | 14.9 |

* The rate increases proposed in the 1989-1991 Development Plan were applied to the parameters of the financial framework of the 1990-1992 Development Plan

**Figure 6.4**
Sources of Financing for the 1990-1992 Period, Including Proposed Rate Increases




| | |
|---|---|
| Issue of long-term debt and other sources | 72% |
| Other funds* | 14% |
| Net income | 14% |
| Total: | 100% |

*Principally depreciation of fixed assets

| | |
|---|---|
| Payroll | 18% |
| Other expenditure** | 14% |
| Taxes | 6% |
| Interest and exchange loss | 40% |
| Net income | 12% |
| Amortization | 10% |
| Total: | 100% |

**Including energy purchases

## *6.6 Financial Framework of the Average Scenario*

The financial framework of the average scenario integrates the utility's strategies for fulfilling its mandate and carrying out its development plan. This framework is also a forecast which takes into account the financial orientations adopted, as well as the most probable assumptions with respect to changes in the economic and energy contexts.

### *6.6.1 Economic Outlook*

The North-American economy behaved differently from the European and Japanese economies in 1989. In Japan and Europe, economic growth continued to accelerate throughout the year, forcing central banks in those countries to adopt increasingly restrictive monetary policies to check inflationary trends. In North America, on the other hand, economic activity slowed markedly in 1989, especially during the second half of the year, in response to the restrictive monetary policies introduced in 1988. As a result, inflationary pressures began to diminish in mid-year. The US Federal Reserve Board was more prompt than the Bank of Canada in reducing interest rates, acting during the summer. In Canada, interest rates remained high at year-end, with the consequence of strengthening the Canadian dollar. The US dollar appreciated against European and Japanese currencies in 1989.

In 1990, economic activity in Europe and Japan should remain constant and result in inflationary pressures, high interest rates and an appreciation of their currencies against the US dollar. In North America, however, the weakness in economic activity should persist for most of the year, leading to a slight reduction in inflation and a loosening of monetary policies. The gradual reduction in interest rates in Canada will cause the Canadian dollar to lose value against the US dollar.

It should be noted that the introduction of the 7% federal Goods and Services Tax in Canada planned for January 1, 1991 should provoke earlier spending by consumers and stimulate the economy in the second half of 1990.

As in the United States and the rest of Canada, Québec will experience a second year of slower economic growth in 1990. The increase in Québec's Gross Domestic Product in real terms should be about 1.7%, which is slightly higher than the growth forecast for Canada as a whole. It is principally the strength of non-housing investment that will support the economy.

**Table 6.11**
Comparison of Economic Forecasts for 1990

| Parameters | Principal Forecasts Average | Principal Forecasts Upper Quartile | Principal Forecasts Lower Quartile | Forecasts by Hydro-Québec |
|---|---|---|---|---|
| **Rate of growth of Quebec's real gross domestic product (in %)** | 1.6 | 2.0 | 0.7 | 1.7 |
| **Rise in the Canadian Consumer Price Index (in %)** | 4.8 | 5.6 | 4.3 | 4.6 |
| **Interest rates on bonds 10 years and over (in %)** | | | | |
| – Government of Canada | 9.3 | 9.7 | 8.9 | 9.5 |
| – Government of the United States | 7.7 | 8.3 | 7.2 | 8.0 |
| **Rate of exchange of Canadian dollar at December 31** | | | | |
| – US dollar | 0.826 | 0.853 | 0.810 | 0.810 |
| – Deutsche mark | 1.48 | 1.73 | 1.34 | 1.34 |
| – Swiss franc | 1.35 | 1.52 | 1.20 | 1.16 |
| – yen | 138.7 | 147.4 | 113.6 | 109.3 |
| **Average rate of exchange for the Canadian dollar for the year** | | | | |
| – US dollar | 0.839 | 0.857 | 0.825 | 0.818 |
| – Deutsche mark | 1.44 | 1.59 | 1.34 | 1.35 |
| – Swiss franc | 1.29 | 1.42 | 1.17 | 1.18 |
| – yen | 127.3 | 136.1 | 112.2 | 113.5 |

### *6.6.2 Results*

The marked deterioration in 1990 results is the outcome of the low runoff of recent years. After 1990, the ending of exceptional measures introduced to ensure energy reliability, plus continuing efforts to improve productivity and the proposed rate increases will gradually put the utility in a better financial position.

Self-financing and return on equity will fall markedly in 1990, but will subsequently return to minimum levels. Although interest coverage will fall in 1990, it will remain above the minimum level of 1.0 and subsequently rise. Capitalization will fall below its 25% minimum, thus preventing the declaration of dividends over the 1990-1992 period.

**Table 6.12**
Principal Parameters of the Financial Framework of the Average Scenario

| | 1988 | 1989 | 1990 | 1991 | 1992 |
|---|---|---|---|---|---|
| **Rate of growth of Quebec's real gross domestic product** (in %) | 5.4 | 2.2 | 1.7 | 2.2 | 3.0 |
| **Volume of sales** (in terawatthours) | | | | | |
| • Sales of firm electricity in Québec | 119.8 | 127.6 | 126.2 | 134.2 | 139.4 |
| • Sales of surplus electricity in Québec | 8.7 | 0.3 | – | – | – |
| • Export sales of firm electricity | 9.2 | 8.8 | 11.6 | 12.6 | 12.8 |
| • Export sales of surplus electricity | 7.7 | 0.9 | – | – | – |
| • Total sales | 145.4 | 137.6 | 137.8 | 146.8 | 152.2 |
| **Rate of growth of sales volume** (in %) | | | | | |
| • Sales of firm electricity in Québec | 8.5 | 6.5 | –1.1 | 6.3 | 3.9 |
| • Sales of surplus electricity in Québec | –36.5 | –96.6 | –100.0 | – | – |
| • Export sales of firm electricity | 10.2 | –4.3 | 31.8 | 8.6 | 1.6 |
| • Export sales of surplus electricity | –62.3 | –88.3 | –100.0 | – | – |
| • Total sales | –4.9 | –5.4 | 0.1 | 6.6 | 3.7 |
| **Average rate increase*** (in %) | 3.9 | 4.3 | 7.5 | 7.5 | 6.0 |
| **Rise in Canadian Consumer Price Index** (in %) | 4.1 | 4.9 | 4.6 | 5.7** | 5.2 |
| **World price of a barrel of crude oil** (in US dollars) | 16.0 | 19.7 | 20.0 | 21.0 | 22.5 |
| **Interest rates on Hydro-Québec bonds 10 years and over** (in %) | | | | | |
| • Canadian market | 10.8 | 10.5 | 10.3 | 10.6 | 10.7 |
| • US market | 9.9 | 9.3 | 9.0 | 9.6 | 10.6 |
| **Rate of exchange of Canadian dollar at 31 December** | | | | | |
| • US dollar | 0.839 | 0.863 | 0.810 | 0.800 | 0.775 |
| • Deutsche mark | 1.48 | 1.46 | 1.34 | 1.38 | 1.28 |
| • Swiss franc | 1.26 | 1.33 | 1.16 | 1.21 | 1.06 |
| • yen | 104.7 | 124.3 | 109.3 | 108.0 | 92.5 |

* On May 1 of each year and according to the assumption used for 1990, 1991 and 1992
** 1.4% can be attributed to the application of the new Goods and Services Tax (GST)

**Table 6.13**
Financial Framework of the Average Scenario – Results
(in millions of dollars)

| | 1988 | | 1989 | | 1990 | | 1991 | | 1992 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $ | % | $ | % | $ | % | $ | % | $ | % |
| **Revenue** | | | | | | | | | | |
| • Firm electricity-Québec | 4,650 | 11.2 | 5,192 | 11.7 | 5,495 | 5.8 | 6,217 | 13.1 | 6,832 | 9.9 |
| • Surplus electricity-Québec | 102 | -29.0 | 3 | -97.1 | 0 | -100.0 | 0 | – | 0 | – |
| • Electricity exports | 471 | -33.9 | 308 | -34.6 | 384 | 24.7 | 435 | 13.3 | 502 | 15.4 |
| • Other operating income | 55 | 96.4 | 56 | 1.8 | 59 | 5.4 | 61 | 3.4 | 63 | 3.3 |
| **Total** | 5,278 | 4.1 | 5,559 | 5.3 | 5,938 | 6.8 | 6,713 | 13.1 | 7,397 | 10.2 |
| **Expenditure** | | | | | | | | | | |
| • Operations | 1,391 | 14.1 | 1,597 | 14.8 | 1,788 | 12.0 | 1,902 | 6.4 | 2,062 | 8.4 |
| • Other | 969 | 7.7 | 1,162 | 19.9 | 1,245 | 7.1 | 1,255 | 0.8 | 1,399 | 11.5 |
| **Total** | 2,360 | 11.4 | 2,759 | 16.9 | 3,033 | 9.9 | 3,157 | 4.1 | 3,461 | 9.6 |
| **Income before interest and exchange loss** | 2,918 | -1.1 | 2,800 | -4.0 | 2,905 | 3.8 | 3,556 | 22.4 | 3,936 | 10.7 |
| **Interest and exchange loss** | | | | | | | | | | |
| • Interest | 2,050 | -5.5 | 2,165 | 5.6 | 2,392 | 10.5 | 2,571 | 7.5 | 2,698 | 4.9 |
| • Exchange loss | 249 | -8.2 | 70 | -71.9 | 112 | 60.0 | 106 | -5.4 | 139 | 31.1 |
| **Total** | 2,299 | -5.8 | 2,235 | -2.8 | 2,504 | 12.0 | 2,677 | 6.9 | 2,837 | 6.0 |
| **Net income** | 619 | 21.5 | 565 | -8.7 | 401 | -29.0 | 879 | 119.2 | 1,099 | 25.0 |
| **Maximum dividends likely to be declared** | 461 | | 238 | -48.4 | 0 | -100.0 | 0 | – | 0 | – |
| **Dividends declared** | 300 | | 182 | -39.3 | 0 | -100.0 | 0 | – | 0 | – |
| **Expenditure, interest and exchange loss** | 4,659 | 2.2 | 4,994 | 7.2 | 5,537 | 10.9 | 5,834 | 5.4 | 6,298 | 8.0 |
| **Gross interest** | 2,359 | -2.2 | 2,558 | 8.4 | 2,842 | 11.1 | 3,100 | 9.1 | 3,378 | 9.0 |
| **Investment** | | | | | | | | | | |
| • Gross investment | 2,107 | 24.9 | 2,465 | 17.0 | 3,480 | 41.2 | 4,592 | 32.0 | 5,093 | 10.9 |
| • Less: capitalized borrowing expense | 257 | 34.0 | 323 | 25.7 | 378 | 17.0 | 458 | 21.2 | 606 | 32.3 |
| **Net investment** | 1,850 | 23.7 | 2,142 | 15.8 | 3,102 | 44.8 | 4,134 | 33.3 | 4,487 | 8.5 |
| **Borrowings** | | | | | | | | | | |
| • Net issue of long-term debt | 1,860 | 1.0 | 2,894 | 55.6 | 3,205 | 10.7 | 4,414 | 37.7 | 4,921 | 11.5 |
| • Less: redemption of long-term debt | 1,249 | -18.9 | 1,223 | -2.1 | 1,026 | -16.1 | 1,544 | 50.5 | 1,801 | 16.6 |
| **Net borrowings** | 611 | 102.5 | 1,671 | 173.5 | 2,179 | 30.4 | 2,870 | 31.7 | 3,120 | 8.7 |

**Table 6.14**
Principal Financial Ratios

| | 1988 | 1989 | 1990 | 1991 | 1992 |
|---|---|---|---|---|---|
| Interest coverage | 1.26 | 1.12 | 1.05 | 1.17 | 1.19 |
| Capitalization (in %) | 26.2 | 25.9 | 24.7 | 24.5 | 24.4 |
| Return on equity (in %) | 8.0 | 7.0 | 4.8 | 9.7 | 10.9 |
| Average cost of debt (in %) | 10.5 | 11.2 | 11.4 | 11.2 | 10.9 |
| Self-financing (in %) | 34.0 | 30.0 | 25.8 | 27.5 | 29.0 |
| Profit margin (in %) | 11.7 | 10.2 | 6.8 | 13.1 | 14.9 |

| | | |
|---|---|---|
| Interest coverage | = | Income before interest and exchange loss + Net investment income / Gross interest charges * |
| Capitalization | = | Shareholder's equity / Shareholder's equity + Total debt ** |
| Return on equity | = | Net income / Shareholder's equity (average of year) |
| Average cost of debt | = | Gross interest charges* + net loss on redemption of long-term debt / Total debt ** (average of year) |
| Self-financing | = | Total funds provided by operation – Dividends declared / Investment + Redemption of long-term debt |
| Profit margin | = | Net income / Total revenue |

* Interest on debt securities + amortization of debt-security discount and expenses
** Long-term debt + Notes payable + Long-term debt payable within one year + Perpetual debt

### 6.6.3 *Sensitivity Analysis*

Financial forecasts are subject to the vagaries of the economic and energy contexts, and variations in climatic conditions. In the short and medium term, runoff levels are the source of the largest potential inaccuracies in the utility's financial forecasts, although exchange and interest-rate fluctuations may also be disruptive.

The financial framework assumes that 1990 will be a year of average runoff. Should low runoff levels persist through 1990, net income could be reduced by some $270 million, while heavy runoff could increase it by some $30 million.

The effect of rate increases introduced on May 1 will not be fully felt until the following years. A difference of 1% in the 1990 rate increases would have an impact of about $50 million on 1991 net income.

**Table 6.15**
Sensitivity of 1990 Net Income

| Parameter | Variation | Variation in net income (in millions of dollars) |
|---|---|---|
| Rates | 1% as of May 1 | 31 |
| Operating expenditure | +1% | –20 |
| Interest rates | +1% | –27 |
| Exchange rate of Canadian dollar in US dollars | +0.01 US dollar | 2 |
| Exchange rate of Canadian dollar against a basket of currency other than the US dollar | +1% | 4 |

### *6.6.4 Comparison with the 1989-1991 Development Plan*

Net income for 1989 was $565 million, as against the $652 million forecast in the 1989-1991 Development Plan. The continuing low runoff cycle in 1989 reduced net income by more than $250 million. However this was largely offset by revenue from Québec sales of firm electricity, which was over $100 million above the forecast, mainly as a result of colder temperatures, and by the value of the Canadian dollar, which was stronger than expected.

Forecast net income for 1990 is $401 million, or $311 million less than the $712 million forecast in last year's Development Plan. Total revenue is less than 1% above that forecast last year, despite a rate increase that is 3% higher than forecast. This increase is in fact diluted in large part by the revenue loss resulting from the buyback of dual-energy contracts.

Total expenditure is over $300 million in excess of last year's forecast. The continued use of exceptional measures to counteract low runoff results in additional expenditure of over $200 million, and a future amount of over $100 million against last year's forecast is spent on intensified quality of service measures, energy efficiency and employee training.

Interest charged to operations is up by $92 million in 1990, with the increased volume of borrowings in 1989 and 1990, the short-term rise in interest rates and the decrease in interest capitalized to Construction, all of which are partially offset by the strengthening of the Canadian dollar and the downward revision of long-term interest rates.

The unexpected strength of the Canadian dollar and the impact of swaps used in the exchange-risk management program reduce anticipated exchange loss by $60 million.

**Table 6.16**
Comparison with the 1989 – 1991 Development Plan
Principal Parameters of the Financial Framework

| | 1989 | | | 1990 | | |
|---|---|---|---|---|---|---|
| | **Plan 1989-1991** | **Actual** | **Variation** | **Plan 1989-1991** | **Plan 1990-1992** | **Variation** |
| **Rate of growth of Québec's real gross domestic product** (in %) | 2.2 | 2.2 | – | 2.3 | 1.7 | –0.6 |
| **Volume of sales** (in terawatthours) | | | | | | |
| • Sales of firm electricity in Québec | 125.4 | 127.6 | 2.2 | 130.1 | 126.2 | –3.9 |
| • Sales of surplus electricity in Québec | 0.6 | 0.3 | –0.3 | – | – | – |
| • Export sales of firm electricity | 9.2 | 8.8 | –0.4 | 11.0 | 11.6 | 0.6 |
| • Export sales of surplus electricity | 3.2 | 0.9 | –2.3 | – | – | – |
| • Total sales | 138.4 | 137.6 | –0.8 | 141.1 | 137.8 | –3.3 |
| **Rate of growth of sales volume** (in %) | | | | | | |
| • Sales of firm electricity in Québec | 4.7 | 6.5 | 1.8 | 3.7 | –1.1 | –4.8 |
| • Sales of surplus electricity in Québec | –93.0 | –96.6 | –3.6 | –100.0 | –100.0 | – |
| • Export sales of firm electricity | 0.5 | –4.3 | –4.8 | 19.4 | 31.8 | 12.4 |
| • Export sales of surplus electricity | –58.4 | –88.3 | –29.9 | –100.0 | –100.0 | – |
| • Total sales | –4.8 | –5.4 | –0.6 | 1.9 | 0.1 | –1.8 |
| **Average rate increase*** (in %) | 4.7 | 4.3 | –0.4 | 4.5 | 7.5 | 3.0 |
| **Rise in Canadian Consumer Price Index** (in %) | 4.7 | 4.9 | 0.2 | 4.5 | 4.6 | 0.1 |
| **World price of a barrel of crude oil** (in US dollars) | 17.0 | 19.7 | 2.7 | 19.0 | 20.0 | 1.0 |
| **Interest rates on Hydro-Québec bonds 10 years and over** (in %) | | | | | | |
| • Canadian market | 11.4 | 10.5 | –0.9 | 11.1 | 10.3 | –0.8 |
| • US market | 10.5 | 9.3 | –1.2 | 10.8 | 9.0 | –1.8 |
| **Rate of exchange of Canadian dollar at 31 December** | | | | | | |
| • US dollar | 0.800 | 0.863 | 0.063 | 0.781 | 0.810 | 0.029 |
| • Deutsche mark | 1.27 | 1.46 | 0.19 | 1.27 | 1.34 | 0.07 |
| • Swiss franc | 1.08 | 1.33 | 0.25 | 1.08 | 1.16 | 0.08 |
| • yen | 91.2 | 124.3 | 33.1 | 91.2 | 109.3 | 18.1 |

*Applicable on May 1 of each year.

**Table 6.17**
Comparison with the 1989-1991 Development Plan
Results of the Average Financial Framework
(in millions of dollars)

| | 1989 | | | 1990 | | |
|---|---|---|---|---|---|---|
| | Plan 1989-1991 | Actual | Variation | Plan 1989-1991 | Plan 1990-1992 | Variation |
| **Revenue*** | | | | | | |
| • Firm electricity-Québec | 5,088 | 5,192 | 104 | 5,483 | 5,495 | 12 |
| • Surplus electricity-Québec | 7 | 3 | –4 | 0 | 0 | 0 |
| • Electricity exports | 373 | 308 | –65 | 370 | 384 | 14 |
| • Other operating income | 49 | 56 | 7 | 52 | 59 | 7 |
| **Total** | 5,517 | 5,559 | 42 | 5,905 | 5,938 | 33 |
| **Expenditure** | | | | | | |
| • Operations | 1,446 | 1,597 | 151 | 1,554 | 1,788 | 234 |
| • Other | 1,065 | 1,162 | 97 | 1,167 | 1,245 | 78 |
| **Total** | 2,511 | 2,759 | 248 | 2,721 | 3,033 | 312 |
| **Net income before interest and exchange loss** | 3,006 | 2,800 | –206 | 3,184 | 2,905 | –279 |
| **Interest and exchange loss** | | | | | | |
| • Interest | 2,184 | 2,165 | –19 | 2,300 | 2,392 | 92 |
| • Exchange loss | 170 | 70 | –100 | 172 | 112 | –60 |
| **Total** | 2,354 | 2,235 | –119 | 2,472 | 2,504 | 32 |
| **Net income** | 652 | 565 | –87 | 712 | 401 | –311 |
| **Maximum dividends likely to be declared** | 330 | 238 | –92 | 150 | 0 | –150 |
| **Dividends declared** | not determined | 182 | | not determined | 0 | |
| **Expenditure, interest and exchange loss** | 4,865 | 4,994 | 129 | 5,193 | 5,537 | 344 |
| **Gross interest** | 2,619 | 2,558 | –61 | 2,765 | 2,842 | 77 |
| **Investment** | | | | | | |
| • Gross investment | 2,486 | 2,465 | –21 | 3,103 | 3,480 | 377 |
| • Less: capitalized borrowing expense | 380 | 323 | –57 | 426 | 378 | –48 |
| Net investment | 2,106 | 2,142 | 36 | 2,677 | 3,102 | 425 |
| • Interest coverage | 1.17 | 1.12 | –0.05 | 1.16 | 1.05 | –0.11 |
| • Capitalization (in %) | 25.2 | 25.9 | 0.7 | 25.0 | 24.7 | –0.3 |
| • Self-financing (in %) | 31.4 | 30.0 | –1.4 | 33.4 | 25.8 | –7.6 |
| • Return on equity (in %) | 8.1 | 7.0 | –1.1 | 8.4 | 4.8 | –3.6 |

* The revenue for the 1989-1991 Plan is as estimated with the rate increases proposed last year and not the increases actually approved

## 6.7 *Dividend Management*

Dividend management is based on the goal of maintaining Hydro-Québec's financial soundness while allowing the shareholder and therefore all taxpayers to receive a reasonable proportion of the utility's net income as a return on their investment and their share in the public resource that hydroelectricity represents.

The mechanism for declaring dividends provided in the Hydro-Québec Act defines the calculation of the maximum dividend that can be paid to the Québec government as being the distributable surplus. This surplus is 75% of the income available, in a given fiscal year, after the total coverage of gross interest charges, i.e.:

| | | | |
|---|---|---|---|
| Distributable surplus | = | 75% | Income before interest and exchange loss<br>+<br>Net investment income<br>–<br>Gross interest charges |

Calculation of the surplus available for distribution takes into account gross interest charges. This amount generally increases during growing investment, resulting in the reduction of the surplus available for distribution. Moreover, under the Hydro-Québec Act, there are restrictions on the declaration of dividends to guarantee that the utility's financial criteria are not jeopardized by the payment of dividends. No dividend can be declared whose payment would reduce the capitalization ratio below 25% at the end of a fiscal year.

Following discussions with the shareholder, the wisdom of limiting the dividend was confirmed. In addition to the constraints contained in the law, it was agreed to limit the payment of dividends to about half the utility's net income.

In 1989, the dividend mechanism in the law would have allowed a maximum of $238 million to be declared. The shareholder limited the declared dividend to $182 million to protect a self-financing ratio of 30% in 1989. Over the last two years, combined dividends declared have totalled $482 million, although the maximum dividend entitlement was $699 million. This means that the shareholder has ploughed more than $200 million back into the utility over the last two years. For the next three years, the financial framework of the average scenario does not envisage any dividend because the capitalization ratio is projected to be below 25%.

## 6.8 *Financing Activities*

| Objective | Principal Strategies |
|---|---|
| Minimize financing costs and manage financial risks so as to reduce their impact on results, rates and dividends | Maximize financing in Canadian dollars<br>Give preference to terms of 10 years or more<br>Renegotiate outstanding debt when economical to do so<br>Reduce volatility of the cost of debt servicing<br>Maintain the floating-rate debt portion at around 12% |

The proposed financial policy and rate increases will enable Hydro-Québec to finance about 28% of investment and redemption of long-term debt from internal funds for the 1990-1992 period.

Net borrowings required for the construction program total $8.2 billion for 1990-1992, to which are added long-term debt redemptions of $4.4 billion and renegotiations. These needs will require regular access to financial markets and represent major demands on the capacity of its traditional markets. This means a sound financial situation is essential if the utility is to maintain its capacity to manage its debt servicing. It must preserve its credit rating without mortgaging the credit of its guarantor, since Hydro-Québec's debt constitutes 42% of the debt contracted for or guaranteed by the Québec government.

For the next 10 years, the constant high level of borrowings will be unprecedented. Nevertheless, Hydro-Québec's indebtedness will remain at an acceptable level, in relative terms. During the 1990s, debt will represent on average 4.6 times the revenue from electricity sales, virtually the same as at the end of 1989. In the 1970s, when Phase I of the La Grande complex was under way, this figure stood at 5.7.

**Table 6.18**
Source and Allocation of Funds (1990-1992)
(in millions of dollars)

| | 1990 | | 1991 | | 1992 | | Total | |
|---|---|---|---|---|---|---|---|---|
| | $ | % | $ | % | $ | % | $ | % |
| **Allocation of funds** | | | | | | | | |
| Investment | 3,480 | | 4,592 | | 5,093 | | 13,165 | |
| Long-term debt redemptions* | 1,026 | | 1,544 | | 1,801 | | 4,371 | |
| **Need for funds** | 4,506 | | 6,136 | | 6,894 | | 17,536 | |
| **Source of funds** | | | | | | | | |
| Net income | 401 | 9 | 879 | 14 | 1,099 | 16 | 2,379 | 14 |
| Other operating income** | 762 | 17 | 806 | 13 | 899 | 13 | 2 467 | 14 |
| **Self-financing** | 1,163 | 26 | 1,685 | 27 | 1,998 | 29 | 4,846 | 28 |
| Variation in working capital | 138 | 3 | 37 | 1 | -25 | – | 150 | 1 |
| Issue of long-term debt | 3,205 | 71 | 4,414 | 72 | 4,921 | 71 | 12,540 | 71 |
| **Funds available** | 4,506 | 100 | 6,136 | 100 | 6,894 | 100 | 17,536 | 100 |

* Exlcuding renegotiations
** Principally the depreciation of fixed assets

In 1989, Hydro-Québec adopted a strategic financing plan to be able to deal with the major construction of the next decade. The principal objectives of this plan are:

- ensure the completion of the borrowing program, whatever the conditions on the financial markets;
- seek financing at the best cost while trying to limit foreign exchange risk;
- seek an interest-rate structure that minimizes the utility's financial risks and, particularly, achieve an appropriate ratio of fixed-rate to floating-rate debt;
- try to spread maturities in such a way as to facilitate debt refinancing;
- ensure effective management of current debt.

Interest and exchange loss combined represent average annual expenditure in the order of $2.7 billion for the next three years. In this area, Hydro-Québec is pursuing strategies to stabilize the cost of financing and manage its financial risks, as described in the strategic financing plan.

Efforts to maximize financing in Canadian dollars will continue. The Canadian-dollar proportion of debt has risen from 49.9% to 68.5% over the last four years. Moreover, application of the exchange-risk management policy makes it possible to reduce the volatility of the cost of debt servicing by providing maximum hedging of debt in currencies other than the US dollar through currency swaps. Hydro-Québec will also maintain approximately 12% of its long-term debt at a floating rate of interest in order to reduce the average long-term interest rate of its total debt. And it will continue to renegotiate borrowings when this is economical and give preference to maturities of 10 years or more.

**Table 6.19**
Present Situation – Financing Strategies

| | At December 31 | | | |
|---|---|---|---|---|
| | 1986 | 1987 | 1988 | 1989 |
| **Maximize financing in Canadian dollars** | | | | |
| • Portion of debt in Canadian dollars reflecting swaps (in %) | 49.9 | 52.8 | 62.6 | 68.5 |
| **Give preference to maturities of 10 years and more** | | | | |
| • Average maturity of debt issued in the current year (in years) | 18.9 | 16.2 | 15.0 | 23.4 |
| **Renegotiate borrowings when it is economical to do so** | | | | |
| • Renegotiations and recalls (in millions of dollars) | 1,746 | 661 | 591 | 563 |
| • Interest gain for the year (in millions of dollars) | 8.6 | 8.1 | 2.1 | 0.3 |
| • Reduction of exchange loss (in millions of dollars) | 77.4 | 2.4 | (22.4) | (21.2) |
| **Reduce volatility of cost of debt service** | | | | |
| • Swaps on debt already issued (in millions of dollars) | 811 | 275 | 802 | 372 |
| **Maintain approximately 12% of debt at a floating rate of interest to reduce average interest expenditure in the long term** | | | | |
| • Share of debt at variable rate reflecting swaps and perpetual debt (in %) | 8.6 | 9.7 | 13.1 | 12.4 |

# 7

# TECHNOLOGY AND ECONOMIC SPINOFFS

## *7.1 Technology and Its Role in Hydro-Québec's Development*

Technology plays a vital role in Hydro-Québec's development. Indeed, it has been central to the substantial progress made by the utility in recent decades in the expansion and operation of its system. In the years to come, it will remain one of Hydro-Québec's main assets, in light of requirements related to service quality, power-system reliability, the environment, occupational health and safety, and profitability of investment.

With projected spending of almost half a billion dollars, or about 2.4% of projected sales revenue for the next three years, the utility remains one of the principal forces of technological development in Québec. It intends to continue to broaden the structural impact of its technological activities by strengthening as much as possible its cooperative ties with industry, universities, and governmental and private research centres.

It took new steps in this direction in 1989 when it created the *Centre d'innovation technologique en transport d'énergie du Québec* (CITEQ), jointly with Asea Brown Boveri, and endowed a technology-management chair at the *Université du Québec à Montréal*. In addition, early in 1990, Hydro-Québec and its partners will officially launch *Capitecq*, a venture capital fund for the start-up of high-technology companies in the energy sector, with initial funding of $13 million.

### *7.1.1 Expenditure and Objectives from 1990 to 1992*

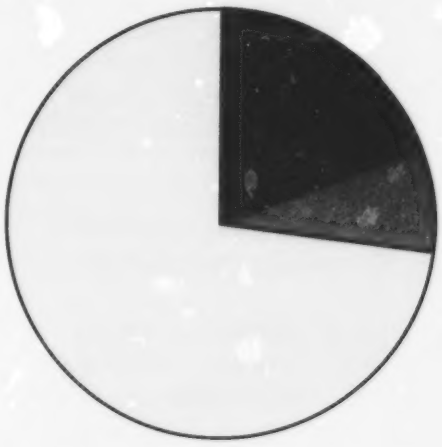
The technological activities planned for 1990-1992 represent expenditure of $467 million (capital and operating expenditure).

These activities will contribute to three objectives:

- gear R & D to Hydro-Québec's needs;
- concentrate long-term research on those avenues most promising to Hydro-Québec;
- market technology and sell expertise to enhance the utility's profitability and to increase Québec exports and the economic spinoffs of Hydro-Québec's activities.

| Objectives | Strategies |
|---|---|
| Focus R & D on Hydro-Québec's needs | Generation:<br>– equipment reliability, durability and output<br>– facility design, construction and upgrading<br>– the environment<br><br>Transmission:<br>– equipment reliability<br>– system simulation<br>– system monitoring and protection<br>– the environment<br><br>Distribution:<br>– equipment reliability and operating flexibility<br>– future development of the system<br>– quality of the electricity supply<br><br>Uses of electricity:<br>– industrial competitiveness and environmental protection<br>– energy conservation and load management<br>– development of electric vehicles<br><br>Product development:<br>– expert systems<br>– systems for power-system management and instant imaging<br>– dual-energy remote control, heat pump with nonelectric backup (PACANE), hydrogen, etc.<br><br>Open new R & D facilities:<br>– turbo-machine laboratory<br>– certification laboratory for distribution equipment<br>– experimental line |
| Concentrate long-term research on most promising avenues | Structure a prospecting network<br>Intensify the search for outside partners<br>Ensure in-house technology transfers |
| Market technology and expertise | Exploit to greater advantage the marketing potential of products and expertise<br>Support the activities of subsidiaries to a greater extent<br>Reinforce current marketing of products and expertise |

**Figure 7.1**
General Breakdown of Technological Expenditure from 1990 to 1992 – Capital and Operating Expenditure
(in millions of dollars)



| | | |
|---|---|---|
| ■ | Long-term avenues and prospecting network 13% | $ 61 |
| ■ | Marketing 6% | $ 27 |
| ■ | Development of expertise, testing and studies 8% | $ 37 |
| □ | R & D 73% | $342 |
| | Total (in millions): | $467 |

### *7.1.2 R & D Strategies*

R & D activities are divided into six areas: generation, transmission, distribution, uses of electricity, product development and technological-installations development.

**Table 7.1**
R & D Breakdown from 1990 to 1992
Capital and Operating Expenditure
(in millions of dollars)

| | Operating | Capital | Total |
|---|---|---|---|
| Generation | 48.7 | 7.3 | 56.0 |
| Transmission | 102.8 | 13.0 | 115.8 |
| Distribution | 22.3 | 11.4 | 33.7 |
| Uses | 36.1 | 13.2 | 49.3 |
| Product development | 22.8 | 5.2 | 28.0 |
| Installations development | – | 59.2 | 59.2 |
| **Total** | 232.7 | 109.3 | 342.0 |

R & D efforts in the field of generation will assume greater importance from 1990 on, because of the utility's accelerated construction program and its need to be flexible enough to adapt to demand. The focus will be on improving design, construction and rehabilitation methods and on increasing the reliability, durability and productivity of facilities.

Most transmission-related R & D will be on equipment reliability and power-system simulation, and will reinforce the corporate objective of enhanced quality of service.

R & D relating to distribution will focus more on future system development and operational reliability and flexibility. The emphasis will be on designing and developing more reliable and efficient equipment and studying the causes of premature deterioration and aging of key components of the distribution system.

R & D on uses of electricity will focus on more cost-effective penetration of the industrial market by increasing the energy efficiency of processes and enhancing the competitiveness of industry. Much of this activity will be devoted to enhanced energy conservation and load management, particularly through the development of new heating equipment that makes more efficient use of the various energy options during peak periods.

With respect to product development, short-term R & D will concentrate on three main areas: expert systems, telerobots or remote manipulators, and power-system control and instant-imaging systems. The selection and management of development projects will be consolidated by all units involved in product development and marketing.

Lastly, Hydro-Québec will continue to put into place the facilities required to meet its technological objectives and to make them available to electrical-equipment manufacturers or other research centres, when it is profitable to do so.

Projected investment from 1990 to 1992 includes three special facilities to be built with outside partners:

- a turbo-machine laboratory;
- an experimental line in Varennes to study line vibrations;
- a laboratory to certify distribution equipment.

There will also be a laboratory for testing residential equipment and commercial equipment for large-power and energy accounts. This project is included in expenditure relating to the uses of electricity.

### *7.1.3 Strategies for Long-Term Avenues*

Hydro-Québec is now involved in four long-term avenues related to the generation, transmission and use of electricity: nuclear fusion, superconductivity, hydrogen and polymer-electrolyte (ACEP) batteries.

Efforts in coming years will be centred on three strategies:

1) Structure a prospecting network to orient long-term technological-exploration activities and influence Hydro-Québec's development strategies as required

Rapid changes in technology require that Hydro-Québec be alert to developments in areas of particular interest to it and be prepared for timely involvement in exploratory research or studies.

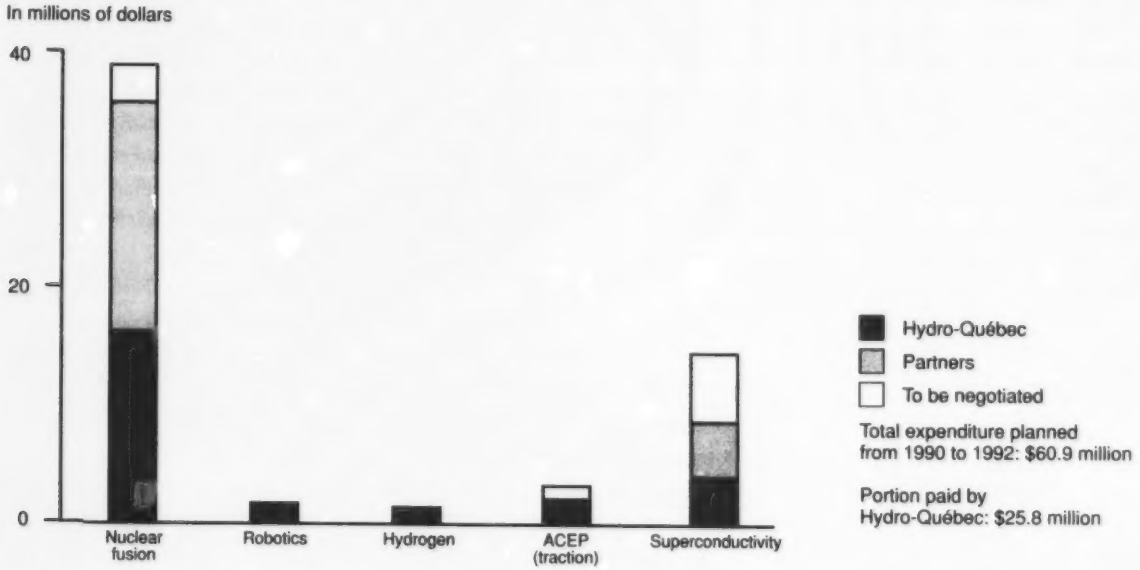
2) Intensify the search for partners

Given the high cost of long-term research, the utility must maximize involvement by partners in financing and carrying out such research. In particular, it must consolidate its joint ventures regarding nuclear fusion and superconductivity and establish similar ventures for hydrogen and ACEP batteries.

3) Ensure technology transfers within the utility

The first objective of these transfers will be to ensure that the intermediate results of long-term research are handled by the units most qualified to apply them to the power system and the utility. Another objective will be to market the by-products of long-term research to obtain optimum profitability from investments.

**Figure 7.2**
Expenditure for Long-Term Avenues



### *7.1.4 Strategies for Marketing Technology and Expertise*

Marketing Hydro-Québec's technological expertise serves two purposes: it contributes to the utility's net income and it spurs the development of Québec's economy by creating new export outlets. Although most marketing activities were formerly divided among Hydro-Québec's ***Bureau de commercialisation des produits technologiques***, Hydro-Québec International (HQI) and the subsidiaries of Nouveler Inc., each now has sufficient expertise to undertake a new development phase.

1) Maximize the marketing potential of products and expertise

As of 1990, the units involved in marketing technological products and expertise will consolidate and combine their efforts with a view to better determining the products and expertise to be developed, evaluating their marketing potential and drawing up sales plans. Hydro-Québec will also establish a policy to protect industrial property so as to preserve its technological know-how.

2) Provide more support for activities of subsidiaries

Hydro-Québec's construction and operations expertise is essential for marketing the products and services offered by HQI. For HQI to be able to take advantage of all sales opportunities and to deliver the best possible products and services, it is important that supply thereof be an integral aspect of sales plans. As of 1990, Hydro-Québec plans to add resources to the units that perform a substantial amount of work for HQI.

Hydro-Québec will also provide further support for the marketing of products it develops to meet its own needs, by offering the subsidiaries that market them guaranteed access to its own market, and by promoting these products outside the utility.

3) Strengthen marketing of technology and expertise

HQI will strengthen its expertise in financial packaging, international representations to customers and investors, and its ability to offer a complete range of products and services. Hydro-Québec will also strengthen its existing and future subsidiaries by giving them product ranges that have manufacturing and marketing similarities.

## *7.2 Economic Spinoffs*

Hydro-Québec is responsible for developing Québec's hydroelectric resources and contributing to the province's economic growth. To this end, the utility has considerable economic levers at its disposal. The first are related to the substantial human resources and physical plant required for its construction program and the operation of its installations. For example, the utility's operating activities and expenditure alone make a direct and indirect contribution to Québec's economy estimated at nearly 5% of the gross domestic product. Moreover, to maximize the impact of its purchasing power, in January 1989 Hydro-Québec adopted a policy setting out economic-development strategies and orientations to promote the manufacture in Québec of the strategic equipment it requires.

Fulfilling its mandate to supply electricity under the best possible conditions is also a major lever of economic development. More specifically, the utility's attractive rates, combined with marketing programs, enable companies in Québec to improve their ability to compete and thus enhance Québec's industrial dynamism. Lastly, Hydro-Québec is also involved in Québec's economic development by contributing to the government treasury.

*7.2.1 Jobs Sustained*

Over the next three years, the total number of jobs sustained by Hydro-Québec's activities will increase by 24,600 person-years, from 62,500 person-years in 1989 to 87,100 person-years in 1992. This level compares favorably with the 70,000 jobs forecast for 1991 in the 1989-1991 Development Plan.

**Construction Program and Operations**

In 1989, Hydro-Québec began a new phase of the expansion of its generating facilities. In the years to come, the utility will also be spending substantial amounts to maintain existing installations and strengthen the transmission and distribution systems.

In the next three years, total capital expenditure (excluding grants, investments and loans) will be $12.8 billion, although the figure forecast in last year's Plan was $10.5 billion. The main reasons for this difference are earlier construction of the La Grande 1, Brisay and Laforge 1 projects and accelerated construction of the Grande Baleine project.

This capital expenditure will create substantial economic spinoffs. Direct construction-related jobs for employees of Hydro-Québec and its contractors will increase from 10,400 person-years in 1989 to over 18,100 in 1992. Indirect employment at suppliers will increase from 11,500 to 20,000 person-years.

Furthermore, the utility's operating activities from 1990 to 1992 will require about 19,000 employees and will help sustain an average of 9,000 indirect jobs.

Over the longer term, from 1993 to 1999, gross annual investment will average $6.8 billion according to the average scenario, in comparison with the $5.5 billion forecast for the same period in the 1989-1991 Development Plan. This substantial increase is to a large extent due to earlier construction of Eastmain 1 and of the Nottaway-Broadback-Rupert (NBR) complex. Commissioning of the first NBR generating stations is scheduled for early in the next century.

**Québec Content of Goods and Services**

| Objectives | Strategies |
|---|---|
| Maximize economic spinoffs of Hydro-Québec's purchases of strategic equipment | Enter into manufacturing agreements whereby Hydro-Québec guarantees the supplier a market in return for an undertaking to manufacture the product in Québec and conduct an R & D program<br><br>Enable companies to test their new products on the Hydro-Québec power system, according to pre-determined conditions<br><br>Promote, in cooperation with the *Institut de recherche d'Hydro-Québec* (IREQ), the establishment in Québec of companies manufacturing new products<br><br>Enter into compensation agreements whereby, in exchange for a guaranteed market for one product, manufacturers undertake to produce in Québec another strategic product used by Hydro-Québec |

Hydro-Québec can maximize its impact on Québec's economy through measures to raise the Québec content of its purchases, especially those of strategic equipment, which accounted for about 25% of its total purchases in 1989. This type of equipment, which will represent about 30% of construction-related purchases in the next three years, requires special attention. The Québec content of Hydro-Québec's purchases varies widely. In 1989, goods and services purchased by the utility had an overall Québec content of 76%, or 57% for goods and 94% for services and construction work. The Québec content of strategic equipment purchased in 1989 was 66%. If, however, primarily electrical equipment and apparatus are considered, excluding cables and conductors, steel for lines and substations, and metal cables and guy wires, then the figure drops to 51%. Strategic equipment also represents an important target because its reliability and availability have a direct impact on service continuity and quality, and, for many products, the utility is the main purchaser in Québec.

The Canada-US Free Trade Agreement is causing, and further integration of the European Community in 1992 will also cause, widespread rationalization. Rather than winding down, this trend will accelerate in the years to come, and Hydro-Québec intends to take advantage of the possibilities so created to further develop Québec's electrical industry. To do so, in line with the utility's policy of promoting economic development through its purchasing power, it will emphasize two key aspects: product quality and R & D. It will encourage its suppliers to meet ever-higher quality standards and will give priority to suppliers that channel effort and investment into R & D in Québec, so that increasingly competitive products can be developed for export worldwide.

In 1989, Hydro-Québec entered into three manufacturing agreements. The first, contingent on competitive prices, concerns the manufacture in Québec of series compensation equipment for the transmission system at a cost of close to $250 million. The second is for the manufacture, in Québec, of resistive voltage detectors designed by IREQ. The value of this agreement is estimated at $1.5 million. The third agreement, to cost close to $1.2 million, is for the manufacture in Québec of snap-on insulator-holders for the distribution system.

In addition, an R & D program, carried out jointly by Hydro-Québec and a manufacturer under a manufacturing agreement, has led to the development of a cold-temperature $SF_6$ circuit breaker, the first of its kind in the world. The two parties are now negotiating an understanding that will guarantee Hydro-Québec a competitive cost price and the manufacturer a sufficient initial order to start production.

The objective and strategies outlined last year, under the policy of promoting economic development through purchasing, yielded encouraging results and so will remain the same in the years to come. The utility intends to pursue this policy to increase the Québec content of strategic equipment. And in the prevailing context of market globalization, Hydro-Québec will study the newcomer markets more closely, to obtain its strategic equipment at the best possible conditions.

## Marketing and Energy-Efficiency Programs

| Objective | Strategies |
|---|---|
| Maximize the comparative advantages of hydroelectricity as a factor in the location and development of industry | Offer risk-and-profit-sharing formulas to industrial customers for whom electricity is a major production factor<br>Continue the Electrotechnology Implementation Assistance Program, begun in 1988, with emphasis on electrical efficiency<br>Ensure research, development and demonstration of electrotechnologies |

In line with its development objective for Québec markets, Hydro-Québec has drawn up a marketing plan that focuses primarily on large-power users. These are primarily the pulp and paper, smelting and refining, and chemical industries. Their ability to compete has enabled them to secure a significant portion of domestic and foreign markets.

With the international scene becoming increasingly competitive, Québec industries must be able to rely on favorable electricity rates to maintain and increase their growth. Another of Hydro-Québec's concerns is ensuring that electricity is used as efficiently as possible. The costs of generation are constantly rising, so it is important to avoid waste. The utility's marketing programs reflect these various concerns.

Electricity-intensive industries that want to locate in Québec can reduce their risks by negotiating with Hydro-Québec contracts based on risk and profit sharing. In 1989, four new contracts were added to the nine signed since 1986 under the risk-and-profit-sharing program. The four contracts represent a total capacity of 1,545 megawatts and are related primarily to aluminum smelter projects.

The US firm Alumax will, by 1992, spend $1 billion to construct an aluminum smelter with an annual capacity of 215,000 tonnes in Deschambault. The Alouette Inc. smelter, also with a capacity of 215,000 tonnes, will start up in Sept-Îles in 1992, at a cost of $1.2 billion. It has the option to double its production capacity in 1995. Reynolds will spend $500 million to add 120,000 tonnes to its existing capacity at Baie-Comeau. All told, these projects represent 1,800 permanent direct jobs.

Hydro-Québec also runs an Electrotechnology Implementation Assistance Program to demonstrate efficient electrical processes and to promote their adoption by Québec industries. Phase I of the program generated 500 projects and $230 million in investment. By 1992, Hydro-Québec expects phase II to add 250 projects entailing investment of $150 million.

Although this very successful program is available to companies of all sizes, it is of special benefit to small and medium-sized businesses. So, while there have been major-spending projects, such as Pétromont's replacement of gas turbines with electric motors, there have also been a large number of cases of the introduction of electrical processes into small and medium-sized businesses, such as the heat pump, electrical resistance and infrared. And new high-performance technologies such as microwaves, high frequencies, osmosis and mechanical steam recompressors, are gradually being introduced into Québec industries.

In the years to come, Hydro-Québec will also promote energy efficiency by the setting-up of various energy-conservation programs. More specifically, it will subsidize the purchase of electrical equipment and accessories that use less electricity. The utility is also likely to institute a program to evaluate the energy-conservation potential of its various customers.

Jobs sustained by electricity-marketing activities will increase from 14,800 person-years in 1989 to 20,400 in 1992.

In conclusion, Hydro-Québec's activities have a permanent impact on Québec's economic development, in addition to temporarily sustaining economic activity during construction periods. Its major generation and transmission projects have given rise to hydraulic and project-management expertise that has contributed to the worldwide success of Québec's consulting engineering firms. Similarly, measures to increase the Québec content of its purchases of strategic equipment have contributed to the development of Québec's electrical-equipment industry, and substantial R & D budgets have spurred technological development in the province. Lastly, optimizing hydroelectricity's comparative advantages has helped sustain permanent jobs, particularly in large-power industries.

**Table 7.2**
Jobs Sustained by Hydro-Québec
(in person-years)

| Activity | 1988* | 1989 | 1990 | 1991 | 1992 |
|---|---|---|---|---|---|
| **Operations and investment** | 43,675 | 47,685 | 57,670 | 64,835 | 66,720 |
| Jobs related to operations | 23,475 | 25,775 | 28,020 | 28,055 | 28,680 |
| – Direct | 17,235 | 18,090 | 19,040 | 19,310 | 19,610 |
| – Indirect | 6,240 | 7,685 | 8,980 | 8,745 | 9,070 |
| Jobs related to investment | 20,200 | 21,910 | 29,650 | 36,780 | 38,040 |
| – Direct | 9,530 | 10,415 | 14,260 | 17,665 | 18,065 |
| – Indirect | 10,670 | 11,495 | 15,390 | 19,115 | 19,975 |
| **Marketing** | 11,455 | 14,835 | 22,840 | 24,255 | 20,375 |
| Jobs related to operating activities and investment by large-power industries | 8,625 | 13,915 | 21,390 | 22,255 | 18,460 |
| Jobs related to other marketing programs (dual-energy, electrotechnologies, and energy conservation) | 2,830 | 920 | 1,450 | 2,000 | 1,915 |
| **Total** | 55,130 | 62,520 | 80,510 | 89,090 | 87,095 |

* Revised figures for 1988.

### *7.2.2 Contribution to Québec Treasury*

Hydro-Québec contributes to Québec's economic growth with tax and revenue income, and the Québec government consolidates Hydro-Québec's net income into its general revenue. This amount was $565 million in 1989 and will average $790 million over the next three years. However, for this period, Hydro-Québec does not expect to pay any dividend to its government shareholder.

The utility also makes contributions in the form of real estate taxes and the tax on capital, as well as 3% of its gross revenue from sales of firm electricity in Québec in lieu of property tax on its generating and transmission facilities. These taxes will average $392 million annually from 1990 to 1992.

**Table 7.3**
Hydro-Québec Contribution to Québec Treasury
(in millions of dollars)

| | 1988 | 1989 | 1990 | 1991 | 1992 |
|---|---|---|---|---|---|
| Taxes* | 294 | 324 | 357 | 387 | 433 |
| Net income** | 619 | 565 | 401 | 879 | 1,099 |
| of which dividends*** | 300 | 182 | – | – | – |

* Excluding retail sales tax
** Reflecting assumptions of the financial framework
*** Dividends declared for 1988 and 1989

*The following publications are available on request:*

- *Proposed Hydro-Québec Development Plan 1990-1992 – Horizon 1999, Summary*
- *Hydro-Québec and the Environment*
- *Hydro-Québec and Energy Efficiency*
- *Rates Proposal for 1990-1991*
- *Electricity Demand in Québec*

Hydro-Québec
75, boul. René-Lévesque ouest
Montréal (Québec) Canada
H2Z 1A4
Telephone: (514) 289-2316
Telex: 05561047

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